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GREAT RIVER ENVIRONMENTAL ACTION TEAM (GREAT II) UPPER MISSISSI--ETC(U)
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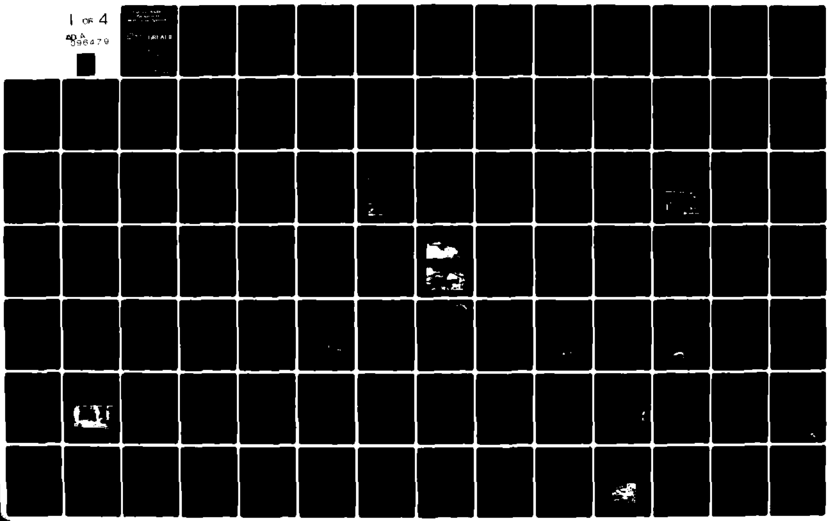

Fish and Wildlife Management Work Group Appendix

FINAL
DECEMBER
1980

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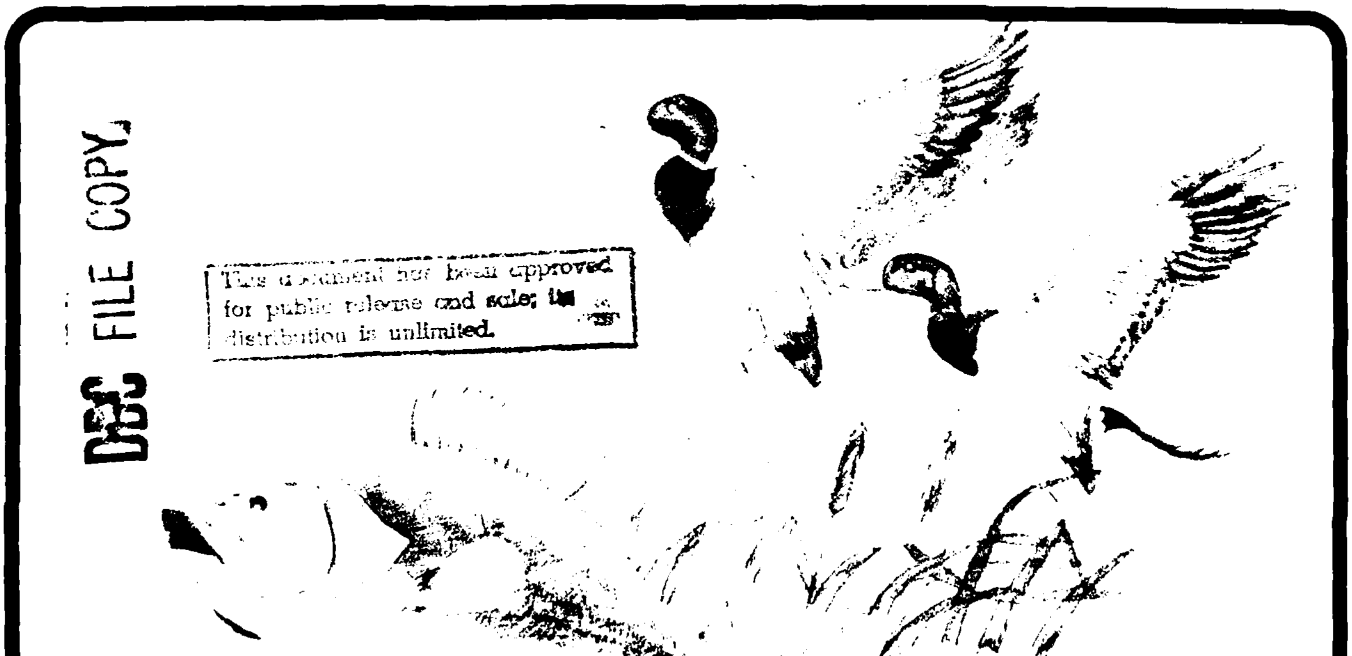
GREAT II

Upper Mississippi River
(Guttenberg, Iowa to Saverton, Missouri)



Great River Environmental Action Team

FINAL

FISH AND WILDLIFE MANAGEMENT WORK GROUP APPENDIX

GREAT RIVER ENVIRONMENTAL ACTION TEAM

(GREAT II)

UPPER MISSISSIPPI RIVER

(Guttenberg, Iowa to Saverton, Missouri).

Appendix. Fish and Wildlife Management Work Group.

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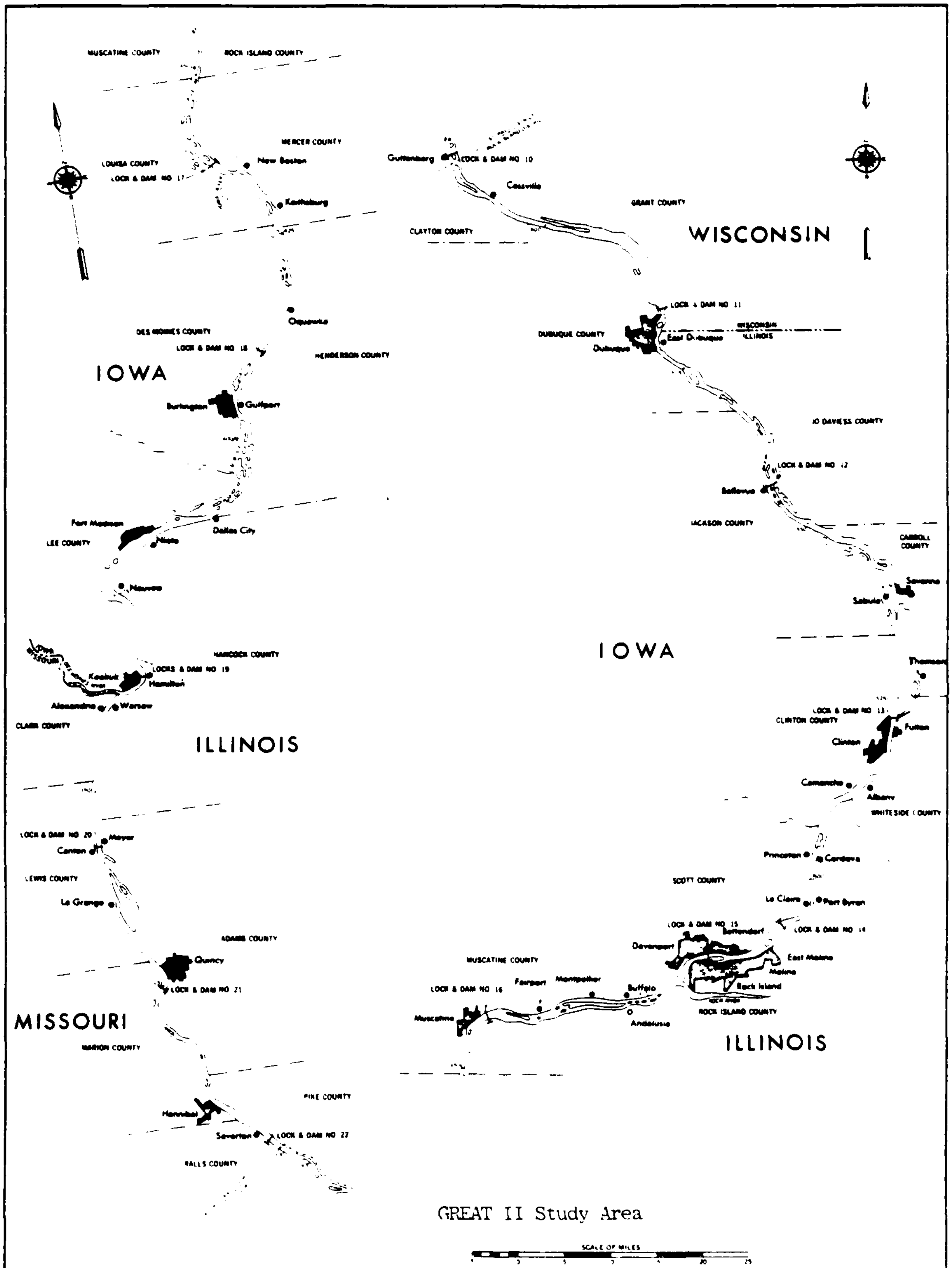

GREAT II Study Area

Figure 1

TABLE OF CONTENTS

LIST OF APPENDICIES

List of Appendicies Continued.

LIST OF TABLES

List of Tables Continued.

LIST OF FIGURES

ACKNOWLEDGEMENTS

Preparation of this appendix has required long hours of discussion, writing, and thought by all the members of the Fish and Wildlife Management Work Group. The following people have been involved at one time or another over the past five years and are thanked for their contributions:

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EXECUTIVE SUMMARY
OF THE
FISH AND WILDLIFE MANAGEMENT WORK GROUP
FINAL REPORT
TO THE
GREAT RIVER ENVIRONMENTAL ACTION TEAM-II

The Mississippi in this area is both a navigation channel for barge traffic and a wild and beautiful maze of backwater sloughs, lakes and floodplain hardwoods. Dams and dredging are used to maintain a 9-foot deep watercourse for national commerce on this stretch of the river. But consistent with nature's course, these efforts to maintain the main channel are also resulting in adverse side effects on the river's remaining areas.

The Upper Mississippi River is one of the most productive areas in the nation for wildlife and fish with several hundred thousand acres set aside as an internationally significant wildlife refuge system. This habitat is abundant; however, much of it, while initially created by or enhanced by the construction of the commercial navigation system, is now facing severe degradation from sedimentation.

The Great River Environmental Action Team (GREAT) was formed in 1974 amidst the turmoil and conflict of agency fighting agency over the 9-foot channel project on the Upper Mississippi River. The issue was primarily the Corps of Engineers' methods of dredged material disposal, but the crux of the matter was the associated destruction and decline of fish and wildlife habitat in the river corridor. In 1974, it was generally believed that improved dredged material disposal methods could solve the problems of habitat decline and destruction. Therefore, GREAT was structured to primarily address the dredging problems and their possible remedies.

The total study program includes three GREAT Teams which have the planning responsibility for the river reaches from St. Paul/Minneapolis to Guttenberg, Iowa (GREAT I); Guttenberg to Saverton, Missouri (GREAT II); and Saverton to the confluence of the Ohio (GREAT III). The GREAT Teams are composed of state and federal agencies having management jurisdiction associated with the river. GREAT II set up thirteen work groups to specifically tackle the several facets of the problem as it was perceived. The Fish and Wildlife Management Work Group (FWMWG) was one of these work groups.

The FWMWG was composed primarily of field level biologists from the States of Iowa, Illinois, Missouri and Wisconsin, and the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service. The FWMWG pursued its objectives by contracting for research and studies with universities and private consultants and by conducting pilot projects and studies themselves. In addition, the FWMWG chairman (U.S. Fish and Wildlife Service) chaired the On-Site Inspection Team which dealt with each year's dredged material disposal problems on a site-by-site basis.

The objective of the FWMWG was:

"To determine the means and to make recommendations for preserving, protecting and enhancing the fish and wildlife resources of the Upper Mississippi River."

The subobjectives were as follows:

1. Recommend the implementation of practices and programs which reduce upland erosion and its associated impacts on fish and wildlife resources. Recommend measures to identify critical areas needing restoration.

2. Recommend and encourage the implementation of navigation project operation and maintenance programs and practices which preserve, restore or enhance fish and wildlife resources. Recommend the implementation of interagency fish and wildlife committee to coordinate programs and practices.

3. Identify voids in our present knowledge of the distribution and abundance of fish and wildlife resources of the UMR. Conduct and recommend studies to fill voids in our knowledge of fish and wildlife distribution.

4. Identify and discuss alteration methods and measures which will improve habitat in off-channel areas.

5. Identify the extent of the area and habitat, if possible, which has been usurped by industrial, agricultual or municipal development. Recommend the implementation of a land use plan to assure an orderly use of the river by all interests. Recommend restoration of areas lost to encroachment. Recommend actions to reduce impacts of encroachment.

6. Identify measures and practices to reduce water quality impacts on fish and wildlife resources.

7. Identify detrimental effects of recreational and commerical traffic on fish and wildlife resources. Recommend measures to minimize impacts on fish and wildlife resources.

8. Distribute information on contracted items.

After the Work Group's objectives were formulated, they identified problems affecting fish and wildlife. Details of these specific problems are found in the FWMWG Appendix.

As part of the problem solving and planning process, the general base conditions of the fish and wildlife resource were documented. This essentially states how many species and what habitat types are found in the GREAT II area. In addition, pool specific base conditions were

developed for the fish and wildlife resource. Future conditions of the resource were also projected to determine possible gains or losses of the resource.

The FWMWG members, as a result of their research, personal knowledge and many hours of discussion, identified the following problems and came to the following conclusions and recommendations:

1. Problem: Fish and wildlife are affected by turbidity and sedimentation resulting from upland and streambank erosion.

   Results and Conclusions: Literature reviews revealed: 1) the value of off-channel areas to fish and wildlife and impacts of construction, operation and maintenance of the 9-foot navigation channel on these areas, 2) methods to create or improve habitat. Review of SCS practices, the GREAT-I SLWG report and interpretation of aerial photographs revealed: 1) habitat lost due to sedimentation and the 9-foot navigation project, 2) effect of current land use practices to minimize erosion, 3) measures to increase effectiveness of erosion control. The ongoing Fulton Flood Control project should provide insight into the feasibility of restoring backwaters. Information on regulations, methods, equipment, impacts and benefits will be provided from this project.

   Selection of environmentally acceptable dredge material disposal sites will minimize the movement of material to backwaters. The literature review details information voids concerning effects of sedimentation on various species of fish and wildlife and suggests the gathering of additional information.

   Recommendations:

   - FWMWG 3003 for U.S. Soil Conservation Service and U.S. Environmental Protection Agency to intensify efforts to control agricultural erosion within the UMR basin.
   - FWMWG 3002 for U.S. Geological Survey to monitor backwater sedimentation rates.
   - FWMWG 3035 to study priority areas for potential backwater restoration.
   - FWMWG 3036 for RID, USFWS, and Iowa Conservation Commission to evaluate a levee for protection of a certain backwater complex.
   - FWMWG 3028 for the COE to develop equipment to do large-scale backwater alterations.
   - FWMWG 3006 to provide the COE with funding necessary to perform selected backwater modifications.

2. Problem: Fish and wildlife resources are adversely affected by operation and maintenance practices associated with the navigation channel.

   Results and Conclusions: The results of the literature studies revealed: 1) the value of off-channel areas to fish and wildlife

and the impacts of the 9-foot navigation project on fish and wildlife, 2) methods to improve or create habitat with dredge material, 3) impacts and benefits of water level manipulation on fish and wildlife. The interpretation of aerial surveys and the GREAT I SEWG report indicated the extent of habitat lost as a result of operation and maintenance of the navigation channel.

Ongoing studies contracted by the work group may provide methods of constructing or altering wing dams to benefit fish and wildlife without affecting the navigability of the channel. Also, studies by the Upper Mississippi River Basin Commission may provide additional information on the effects of main channel dredging, disposal, navigation, etc., on fish. Literature review suggests other studies to gain further information on impacts of the 9-foot channel on fish and wildlife or methods and measures to minimize these impacts. Finally, selection of environmentally acceptable disposal sites should minimize impacts of dredge disposal material on fish and wildlife.

Recommendations:

- FWMWG 3012 to include fish and wildlife resources as a project purpose of the 9-foot navigation project.
- FWMWG 3019 for the RID to eliminate all unwanted disposal of dredged material on federal and state management areas and refuges.
- FWMWG 3001 for the COE to obtain equipment which provides capability to dispose of dredged material on sites which preserve existing fish and wildlife habitat.
- FWMWG 3004 for the state and federal resource agencies to establish a fish and wildlife interagency committee to provide input into river management and decisions and studies.
- FWMWG 3005 for the COE to mitigate past habitat losses caused by dredged material disposal.
- FWMWG 3007 for the RID to include fish and wildlife needs in training and revetment structure repair, alteration, or construction.
- FWMWG 3008 for the RID to determine means to reduce dredging at recurrent dredging sites.
- FWMWG 3009 for RID to evaluate the beneficial and adverse impacts of controlled water level fluctuations.
- FWMWG 3010 for RID to dispose of dredge material at four resource management areas.
- FWMWG 3040 for RID to evaluate possible modifications to backwaters that have habitat losses directly atrributed to the navigation project.

3. Problem: Information on the distribution of abundance of fish and wildlife resources is inadequate for many management decisions.

Results and Conclusions: The literature review suggested numerous studies to improve our understanding of distribution and abundance

of organisms. The main channel study illuminated our understanding of the value of this area to fish and suggested additional studies to gain further information.

Recommendations:

- FWMWG 3013 for the USFWS to obtain data regarding the submergent characteristics of the UMR.
- FWMWG 3026 for the UMRCC to develop and implement detailed fish and wildlife monitoring plan.
- FWMWG 3024 for the USFWS to complete the Geographic Information System for UMR.
- FWMWG 3014 for the USFWS to coordinate a colonial bird monitoring plan.
- FWMWG 3025 for the Iowa Conservation Commission to complete the wing dam study to ascertain relationships between biological and physical parameters of wing dams.
- FWMWG 3031 for the USFWS and the state resource agencies to develop habitat management techniques for threatened and endangered species.

4. Problem: There is a lack of ability to predict response of fish and wildlife to certain alterations of the environment.

Results and Conclusions: The side channel opening reports discuss the impacts/benefits to fish and wildlife of improving and/or restoring off-channel habitat. The literature review suggested studies to gather information on the impacts of a wide variety of alterations. The Fulton Flood Control Project should provide information on the impacts/benefits of dredging sloughs and placement of overburden of river islands.

Recommendations: This problem and problems 3, 5, 6, and 7 are interrelated as much information collected for the other problems will also address this problem. The FWMWG made three recommendations under this problem:

- FWMWG 3029 for the RID to assess the cumulative impacts of riverine development.
- FWMWG 3027 for the RID to complete a habitat development project from silty dredged material and/or evaluate equipment to perform backwater alterations.
- FWMWG 3030 for the RID to monitor sites where dredged material is disposed in the next five years.

5. Problem: Fish and wildlife are affected by industrial, recreational, agricultural, and municipal encroachment.

Results and Conclusions: The literature reviews provided 1) value of off-channel areas to fish and wildlife, 2) impacts of: municipal, agricultural, and industrial encroachment; creating recreation beaches; industrial growth to support navigation. Review of historic and recent photos indicated the amount of habitat lost to agricultural, municipal, and industrial expansion, and the

subsequent loss of agricultural lands to urban and industrial encroachment. The literature review suggested studies evaluating the impacts of encroachment on fish and wildlife.

Recommendations:

- FWMWG 3039 for the Iowa Conservation Commission, Illinois Department of Conservation, and the USFWS to develop a comprehensive management plan for the fish and wildlife resources of Pool 19 (Keokuk Pool).
- FWMWG 3017 for all resource agencies to develop a comprehensive management plan for the fish and wildlife resources of the UMR.
- FWMWG 3016 for all agencies having an interest in the UMR to develop a comprehensive land use plan for the UMR corridor.

6. Problem: Effluent from municipal, agricultural and industrial activities affect fish and wildlife resources.

Results and Conclusions: Literature reviews indicated that poor water quality due to point or non-point land sources and toxic spills from river traffic can seriously degrade fish and wildlife habitat. The literature review suggested studies directed at gaining a better understanding of these problems.

Recommendations:

- FWMWG 3021 for the USFWS and state resource agencies to develop a contingency plan to protect fish and wildlife resource from spills of hazardous or toxic materials.
- FWMWG 3022 for all industries located in the floodplain, which produce or store toxic or hazardous materials to floodproof their facilities.
- FWMWG 3037 for U.S. Coast Guard to complete and enforce regulations to protect the waters of the UMR from adverse spills.
- FWMWG 3038 for the U.S. Environmental Protection Agency to complete and enforce regulations to protect the waters of the UMR from adverse spills.
- FWMWG 3020 for the Federal Railroad Administration to direct railroads along the UMR to protect the river's waters from adverse spills.

7. Problem: Fish and wildlife are affected by commercial and recreational boat traffic.

Results and Conclusions: The literature does not have extensive information on the effects of commercial and recreational traffic on fish and wildlife resources. However, several impacts were noted. The literature review suggested several studies to gain a better understanding of this problem.

Recommendations:

- FWMWG 3032 for the UMRBC master planning effort to identify the impacts of navigation and to develop a predictive model.

- FWMWG 3033 for the COE to identify and evaluate techniques to mitigate navigation-related impacts and to enhance the UMR resources.
- FWMWG 3023 for the RID to complete the biological studies necessary to complete the assessment of establishing year-round navigation or a closed navigation season.
- FWMWG 3034 for the RID to evaluate the impacts of barge fleeting on the study area.

I. INTRODUCTION

The Mississippi is the greatest river in North America, gathering run-off from 31 states and two Canadian provinces, draining 1.5 million square miles. It is the third largest watershed in the world, flowing 2,500 miles to the Gulf of Mexico. Millions of people live on its banks and draw life from its waters. Over five hundred kinds of animals live among the diverse plant communities that thrive in and along the river.

Man, in his progress, has put the river to many varied and sometimes conflicting uses. The pressures of man's use of the river are feared to be degrading the environmental qualities of the river. More information is needed on the complex interactions of the river's resources and these resource reactions to man's activities on the river. When this information is obtained, it can then be used to determine where problems exist and the alternatives available to man to solve these problems and coordinate river uses to minimize conflicts.

I. A. STUDY AUTHORIZATION AND DEVELOPMENT

In response to increasing public concern for the environmental quality of the river, the Great River Study was authorized by Congress in the Water Resources Development Act of 1976 (PL 94-587). This legislation authorizes the U.S. Army Corps of Engineers.... "to investigate and study, in cooperation with interested states and Federal agencies, through the Upper Mississippi River Basin Commission, the development of a river system management plan....".

The total study program includes three Great River Environmental Action Teams (GREAT), which have the responsibility for the river reaches from St. Paul/Minneapolis to Guttenberg, Iowa (GREAT I); Guttenberg to Saverton, Missouri (GREAT II); and Saverton to the confluence of the Ohio (GREAT III).

The study program and recommendations of the three GREAT Teams will be brought together into a river management strategy for the entire Upper Mississippi River. The goal of the study is to present to Congress and the people a river resource management plan that is, above all, realistic - a plan that is technically and economically sound, socially and environmentally acceptable, and capable of being put into action within a reasonable period of time.

I. B. STUDY PURPOSE AND SCOPE

The purpose of the GREAT II Studies is to identify and resolve conflicts resulting from separate legislative actions of Congress

which mandated that the Upper Mississippi River be managed in the national interest for commercial navigation and as a fish and wildlife refuge.

The concept of the study originated from a need to coordinate the maintenance activities of a nine foot navigation channel by the U.S. Corps of Engineers from Guttenberg, Iowa to Saverton, Missouri with other river uses. GREAT II was founded because of increasing concern by conservationists and the general public over the lack of information available about the impacts of U.S. Corps of Engineers channel maintenance activities on many key resources of the river.

The scope of the GREAT II Study is directed toward developing a river system management plan incorporating total river resource requirements. GREAT II was organized early in fiscal year 1977 (October 1976 through September 1977) and is studying the river from Guttenberg, Iowa, to Saverton, Missouri.

I. C. Study Participation and Organization

The GREAT II Team is composed of representatives from the following Upper Mississippi Basin States and the Federal River Resource-oriented agencies:

State of Illinois
State of Iowa
State of Missouri
State of Wisconsin
U.S. Department of the Interior - Fish and Wildlife Service
U.S. Department of Agriculture - Soil Conservation Service
U.S. Department of Defense - Department of the Army - Corps of Engineers
U.S. Department of Transportation - U.S. Coast Guard
U.S. Environmental Protection Agency
Upper Mississippi River Conservation Committee (ex officio)

GREAT II is organized into 12 functional work groups and the Plan Formulation Work Group. Each work group is to accomplish the study objectives as they relate to the work group's functional area and is directed by the team. Work groups are composed of persons having expertise and interest in the work groups area of study.

This report summarizes the concerns, objectives, activities, conclusions and recommendations of the Fish and Wildlife Management Work Group as they relate to the GREAT II Study area.

I. D. Fish and Wildlife Management Work Group Objective

The objective of the FWMWG as described in the GREAT II Plan of Study, June, 1977, is as follows:

> "The primary objective of the Fish and Wildlife Management Work Group is to determine the needs and to make recommendations for preserving, protecting and enhancing the fish and wildlife resources of the Upper Mississippi River. This work group will coordinate the development of short-term recommendations for each year's operation and maintenance season for the entire partnership team."

I. F. Fish and Wildlife Management Work Group Organization

The FWMWG is chaired by a representative of the U.S. Fish and Wildlife Service. The work group consists of biologists from each resource agency in the study area, the Corps of Engineers and several members of the public not affiliated with any agency. The following agencies were represented on the FWMWG:

Wisconsin Department of Natural Resources
Iowa Conservation Commission
Illinois Department of Conservation
Missouri Department of Conservation
U.S. Fish and Wildlife Service
U.S. Army Corps of Engineers

The first work group meeting was held on April 23, 1975. Up until January 1977, meetings were called as necessary then in February 1977, meetings were held on a monthly basis. Beginning in June 1977, it was agreed that meetings would be held the first Tuesday of each month. When it became necessary to vote on a motion, voting was limited to one vote per agency in attendance, and a simple majority was required. A tie vote indicated a positive response.

I. F. Public Participation

The FWMWG has sought out and received extensive public input and participation. Citizens participated in work group meetings and provided direction to the work group through the Public Participation and Information Work Group and public hearings.

The FWMWG provided to the Public Participation and Information Work Group (PPIWG) copies of all correspondence and notices. All responses to information requests or clarification requests by the PPIWG were provided directly to the coordinator of the PPIWG.

The work group believed that the public's interest in fish and wildlife was well represented by the respective agencies; however, prior to any vote being taken, discussion was open to all those in attendance.

I. G. DIVISION OF RESPONSIBILITIES

Responsibilities of all work group members:

1. Review of existing data pertinent to the work group.
2. Problem identification.
3. Develop tasks to address identified problems.
4. Design work group studies.
5. Review work group scopes of work.
6. Review technical proposals.
7. Draft Fish and Wildlife Background section of Work Group Appendix.
8. Review dredge disposal sites.
9. Review and comment on contracted studies.
10. Participate in the On-Site Inspection process.
11. Formulation of recommendations.

Responsibilities of the chairman include:

1. Schedule and preside at the work group meetings.
2. Represent work group on Plan Formulation Work Group.
3. Represent work group at GREAT II Team meetings.
4. Chairman of the On-Site Inspection Team.
5. Represent work group on Dredge Disposal Task Force.
6. Draft minutes of work group meetings.
7. Distribution of all pertinent GREAT II data to work group members.
8. Draft scopes of work.
9. Chairman of Technical Evaluation Committee to review all work group technical proposals for contracted work.
10. Draft Work Group Feasibility Report.
11. Draft Work Group Appendix
12. Final Work Group Appendix

II. PROBLEM IDENTIFICATION

II. A. INTRODUCTION

Once the work group's overall objective was formulated, the work group members began to identify public concerns, use conflicts and other problems related to the over-all objective and area of study. The work group's list of problems was composed of those problems identified in any of the following ways:

The problem was identified in GREAT I and was applicable to the GREAT II area.

The work group recognized an existing problem based on existing conditions.

The work group recognized a potential problem based on future projections of existing conditions and trends.

Other work groups identified concerns relating to the FWMWG's area of study

The public expressed concerns and problems directly to the work group

The public expressed concerns and problems to a work group through the public participation and information work group (i.e. town meetings; houseboat trips; etc.).

These problems were compiled into a list to be evaluated by the work group for relevancy to the study; the urgency or certainty of the problem; and the potential for resolving the problem within the time-frame of the study. Certain problems were eliminated from further study based on criteria guidelines developed by the Upper Mississippi River Basin Commission in 1974. The list of remaining problems was then prioritized by the work group (Table 1).

Once the work group had developed a set of problems and needs, we formulated a list of objectives (Table 2) designed to address and, at a minimum, partially resolve their problems. These objectives were then used to identify tasks and/or studies (Table 3) which the work group needed to accomplish in order to identify the possible alternative solutions to their respective problems. The problems, objectives and tasks therefore represent the plans-of-action the work group used to derive their final conclusions and recommendations.

TABLE 1

Problems Identified by Fish & Wildlife Management Work Group and the Public

1. Statement of Problem	2. Date Identified	3. Agency, Group, ETC. Who Identified	4A. Is the problem being addressed by GREAT II?	4B. If it is, by which task	4C. If it's not. Why not?
1. Fish & wildlife are affected by turbidity & sedimentation resulting from upland & streambank erosion.	1976	GREAT I FWMWG	Yes	1, 2, 3, 4, 5, 6, 7, 8, 15	
2. Fish & wildlife are affected by operation & maintenance practices associated with the nine foot navigation project.	1976	GREAT I FWMWG	Yes	1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17	
3. Information on the distribution and abundance of fish & wildlife resources is inadequate for many management decisions.	1976	GREAT I FWMWG	Yes	7, 8, 10, 11, 12, 13	
4. There is a lack of ability to predict response of fish & wild life to certain alterations of the river environment.	1976	GREAT I FWMWG	Yes	5, 6, 7, 8, 13	
5. Fish & Wildlife are affected by industrial, recreational, agricultural & municipal encroachment.	1977	GREAT II FWMWG	Yes	1, 2, 7, 8, 9, 18, 20	
6. Effluent from municipal, agricultural & industrial activities affect fish & wildlife resources.	1977	GREAT II FWMWG	Yes	7, 8, 19, 20	
7. Fish & Wildlife are affected by commercial & recreational boat traffic.	1977	GREAT II FWMWG	Yes	7, 8, 20	

Table 1 Continued.

1. Statement of Problem	2. Date Identified	3. Agency, Group, ETC. Who Identified	4A. Is the problem being addressed by GREAT II?	4B. If it is, by which task	4C. If it's not. Why not?
8. Discussion of Lead-Steel shot issue	August 1978	Public	No		Issue is being thoroughly studied by [illegible] and state
9. Devils Creek area should be maintained there has been some talk of stream straightening & development.	August 1978	Public	Yes	1, 2, 7, 8, 9, 18, 20	
10. Fishing seems to be declining in the last few years.	August 1978	Public	Yes	1,2,3,4,5,6,7,8, 9,10,11,12,14, 15, 16,17,18,19, 20	
11. Ducks are disappearing on the river-all going to the refuges instead of on the river.	August 1978	Public	Yes	1,2,3,4,5,[illegible],8, 9,10,11,1[illegible] 15,16,17,1[illegible], 20	
12. Fishing is not what it used to be.	August 1978	Public	Yes	1,2,3,4,5,[illegible] 9,10,11,1[illegible] 14,15,16,1[illegible] 19,20	
13. Drop off of fishing in the lower DesMoines.	August 1978	Public	Yes	1,2,3,4,5,[illegible] 8, 9,10,11,12 [illegible] 15,16,17,1[illegible] 20	

TABLE 2

Fish and Wildlife Management Work Group Sub-Objectives

Attainment of the Primary Work Group Objective Will Necessitate Fulfillment of the Following Sub-Objectives:

1. Recommend the implementation of practices and programs which reduce upland erosion and its associated impacts on fish and wildlife resources. Recommend measures to identify critical areas needing restoration.

2. Recommend and encourage the implementation of navigation project operation and maintenance programs and practices which preserve, restore or enhance fish and wildlife resources. Recommend the implementation of interagency fish and wildlife committee to coordinate programs and practices.

3. Identify voids in our present knowledge of the distribution and abundance of fish and wildlife resources on the UMR. Conduct and recommend studies to fill voids in our knowledge of fish and wildlife distribution.

4. Identify and disucess alteration methods and measures which will improve habitat in off-channel areas.

5. Identify the extent of the area and habitat, if possible, which has been usurped by industrial, agricultural or municipal development. Recommend the implementation of a land use plan to assure an orderly use of the river by all interests. Recommend restoration of areas lost to encroachment. Recommend actions to reduce impacts of encroachment.

6. Identify measures and practices to reduce water quality impacts on fish and wildlife resources.

7. Identify detrimental effects of recreational and commercial traffic on fish and wildlife resources. Recommend measures to minimize impacts on fish and wildlife resources.

8. Distribute information on contracted items.

TABLE 3

Tasks Developed by the Work Group to Identify
Solutions to the Respective Problems

Description of Task	Purpose of Task	Person(s) or Group(s) Responsible for Completion of Task	Problems Addressed by Task	Anticipated Completion Date of Task
1. Review existing literature concerning use of backwaters by fish and wildlife resources	Document value of backwaters to fish and wildlife resources	Chairman FWMWG	1, 2, 5, 9, 10, 11, 12, 13,	September 1979
2. Review historic & recent aerial photographs of GREAT II study area	Grossly identify: 1) extent of backwater loss due to sedimentation, 2) extent of habitat loss due to construction, operation & maintenance of the 9-foot navigation channel; 3) extent of habitat loss due to encroachment by agriculture, municipalities, industry & recreation.	Chairmen FWMWG & SCWG	1, 2, 5, 9, 10, 11, 12, 13	September 1979
3. Review GREAT I's SEWG report	Grossly identify extent of backwater losses due to sedimentation, review discussion of value of current erosion practices.	Chairmen FWMWG & SCWG	1, 2, 10, 11 12, 13	September 1979
4. Review Soil Conservation Service erosion control practices and regulations	Identify practices which could reduce erosion.	Chairman FWMWG & SCWG	1, 10, 11, 12, 13	September 1979
5. Review GREAT I & II's Side channel opening reports	Identify methods to rejuvenate backwaters.	Chairman FWMWG	1, 4, 10, 11, 12, 13	September 1979
6. Provide input in the selection of borrow & disposal sites for the Fulton Flood Control Project	Identify potential uses of dredged material. Identify methods to rejuvenate backwaters.	FWMWG	1, 2, 4, 10, 11, 12, 13	September 1979
7. Literature Search	Compile all existing published & unpublished data relating to fish and wildlife of the Upper Mississippi River	Hazelton [illegible]	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13	September 1979

Table 3 Continued.

Description of Task	Purpose of Task	Person(s) or Group(s) Responsible for Completion of Task	Problems Addressed by Task	Anticipated Completion Date of Task
8. Literature review	Identify information gaps in existing literature. Develop priorities & suggest studies to fill the voids.	Hazelton $29,185	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13	February 1980
9. Review literature to assess effects of the construction of the 9-foot navigation channel including its operating & maintenance on fish and wildlife	Document effects on fish and wildlife habitats.	Chairman, FWMWG	2, 5, 9, 10, 11, 12, 13	September 1979
10. Study of the use of the main channel by fish	Document fish use of main channel identify conflicts with navigation & channel maintenance. Identify additional work.	LGL Limited $65,000	2, 3, 10, 11 12, 13	March 1980
11. Study of the effect of notching wing dams on aquatic organisms	Evaluate effectiveness of notching wing dams to aquatic organisms.	U.S. FWS Cooperative Fishery Unit $89,000	2, 3, 10, 11, 12, 13	September 1980
12. Classify wing dams according to physical & hydrological features	Develop basis for formulating environmentally-sound guidelines for the design of new or modification of old training structures.	Iowa Conservation Commission $30,000	2, 3, 10, 11, 12, 13	September 1979
13. Study to assess capability of obtaining submergent characteristics of the Mississippi River	Augment capability to identify aquatic habitat by obtaining depths, submergent vegetation, velocities and sediments	Plan of Study completed only, Hazelton $12,426	3, 4, 10, 11 12, 13	September 1980
14. Participate in selection of short and long term dredge disposal sites	Minimize impacts on fish and wildlife resources. Document impacts on fish and wildlife resources.	FWMWG Chairman acts as chairman of OSIT & member of dredge disposal task force.	2, 10, 11, 12, 13	Continuous

Table 3 Continued.

Description of Task	Purpose of Task	Person(s) or Group(s) Responsible for Completion of Task	Problems Addressed by Task	Anticipated Completion Date of Task
15. Review literature concerning the creation of habitat with dredged materials	Identify methods and types of habitat which can be created with dredged material.	Chairman FWMWG	1, 2, 10, 11, 12, 13	September 1979
16. Review literature regarding manipulation of water levels to benefit fish & wildlife resources	Evaluate effects of water level manipulation on fish and wildlife resources.	Wisconsin DNR	2, 10, 11, 12, 13	September 1979
17. Seed mudflats in Pool 16 exposed by water level manipulation	Improve fish and wildlife habitat.	Joint Venture: FWMWG CE-RID Illinois	2, 10, 11, 12, 13	Depends on water level
18. Review literature concerning effects of industrial, municipal recreational & agricultural encroachment on fish & wildlife resources	Document impacts on fish and wildlife resources.	Chairman FWMWG	5, 9, 10, 11, 12, 13	September 1979
19. Review literature regarding effects of point & non-point discharges on fish & wildlife resources	Document impacts on fish and wildlife resources.	Chairman FWMWG	6, 10, 11, 12, 13	September 1979
20. Review literature concerning effects of commercial and recreational traffic on fish & wildlife	Document impacts on fish and wildlife resources.	Chairman FWMWG	5, 6, 7, 9, 10, 11, 12, 13	September 1979

The Upper Mississippi River serves many in many ways. As each user wants a piece of the river to perform his purpose, conflicting demands occur, and the end result is mass multi-use pressure which oftentimes exploits the resource.

From a fish and wildlife point of view, man's demands and intrusions on the river have led to steady decline of habitat quantity, quality, and diversity. Most of the environmental degradation has been the result of man's disregard and ignorance for the integrity of the resource. Riverine biologists and planners, handicapped by a limited knowledge base with which to understand the complexities of this dynamic resource, have now taken steps to obtain a more thorough understanding of the river's response to man's activities. However, management capability is not enough to assure resource prosperity. Environmental awareness and performance of activities affecting the river, with this in mind, is essential for preservation and enhancement of fish and wildlife domains.

The Fish and Wildlife Management Work Group has attempted to identify those problems which threaten for present and future, the fish and wildlife resources on the river. Throughout the GREAT II study period, the work group has attempted to address these identified problems so that, to the maximum extent possible, conclusions and recommendations could be developed or corrective action taken to preserve, protect and enhance the fish and wildlife resources of the Upper Mississippi River. The problems identified by the work group are discussed below. There is a definite interaction between these problems, and in certain areas the discussion reiterates previous concerns. However, for convenience, these elements are addressed separately.

II. B. SEDIMENTATION

Off channel areas of the UMR provide the diverse habitats which make a unique and highly productive fish and wildlife domain. Natural and impoundment-induced backwaters and wetlands support exceptional vegetational growth which plays a vital role in life functions of fish, waterfowl and furbearers. Intricate networks of sloughs and side channels connect these backwater lakes and ponds, and are essential as a renewable supply of dissolved oxygen to support productivity. The reader is referred to the GREAT II Side Channel Work Group (SCWG II) Appendix for an in-depth discussion of the value of off-channel areas to fish and wildlife.

Impoundment was responsible for the creation of much of the productive marsh and aquatic habitat. However, natural forces

cannot support the continued existence of the new configuration. The reduced ability of the river to transport incoming sediments downstream (FWWG I, 1979)[1] causes sediment to be trapped in backwaters and lower pool areas. Historically, some indiscriminate dredged spoil placement practices (and secondary movement of this material during flooding) by the Corps have intensified the sedimentation problem by closing off side channels and sloughs (SCWG II, 1980) and thereby isolating the off-channel areas from fresh flow oxygenation (Corps 9-foot channel EIS, 1974) and sediment flushing affects. Examples of closed off side channels caused by spoil placement include Cordova Slough, Kingston Bar and Lainsville Slough (SCWG II). However, the vast majority of fine sediments entering the system are carried from the agricultural land in the basin (see Figure 2).

The cumulative impact of sedimentation has accelerated ecological succession of aquatic habitats resulting in losses of water surface area and fish and wildlife habitat decline. McHenry (1975) has estimated life expectancy of UMR backwaters from 50-200 years if present sedimentation rates continue. In terms of habitat loss, the GREAT I Sediment and Erosion Work Group (SEWG I) has found that approximately 25 percent of open water areas in 1939 have been converted to marshland. Such habitat losses have not been totally unexpected and projections (ERT/Ecol. Consultants, 1979; COE, 1974; and Eckblad, 1977) implied that backwaters will slowly be eliminated. A review of historical and recent photographs by the SCWG II revealed a conversion of approximately 9,000 acres of open water habitat to vegetated areas due to sedimentation in the study area between 1956 and 1975. Figure 3 shows the high sediment load entering the Mississippi from the Maquoketa River and the resulting terrestrial formation.

While sedimentation impacts habitat acreage, it also adversely affects environmental quality. Desirable backwater productivity is dependent on water quality. Fine sediments, which remain in suspension until reaching low flow backwater areas, tend to contain rich organic nutrients (from fertilizers) and toxins (from pesticides) which affect water chemistry. Sedimentation and turbidity, caused by sediment resuspension, affects fish and benthos productivity by interferring with reproduction, causing coverage of fish spawning and mussel beds, killing and concealing food sources and reducing photosynthetic oxygen production. Siltation can ultimately cause backwater area stagnation, which results in losses of desirable aquatic organism.

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[1] Fish and Wildlife Work Group of GREAT I

Figure 2. Sedimentation at the mouth of the Maquoketa River.

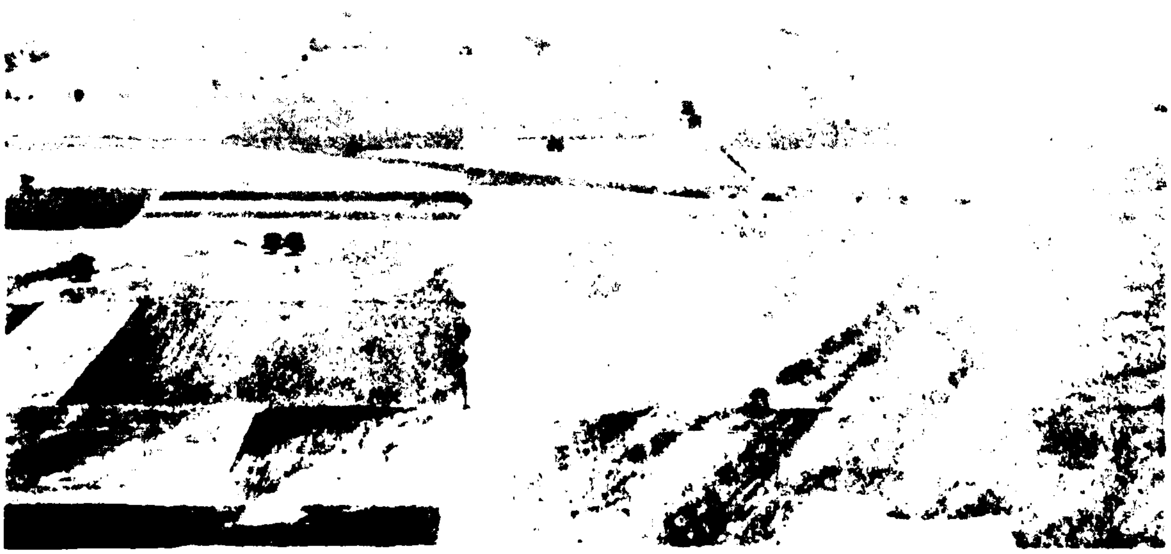


Figure 3. Floodplain agriculture.

Coarse sand sediments, primarily produced at tributary stream-banks, are generally confined to the main channel area. While impacts caused by sand accumulation in the main channel are generally limited to coverage of in-channel structures (and the habitat diversity they provide), side channel blockage by sediment deposition and its isolation effect on backwaters in some cases severely threatens fish and wildlife productivity by inducing sedimentation. Dredge disposal operations have magnified this problem by secondary movement into these side channels (FWWG I, 1979).

Various in-channel protective measures including groin (submerged wing dam) adjustments, aeration culverts, closing dams, dikes, levees, revetments and side channel alterations have proven somewhat successful in reducing sedimentation and stagnation impacts at critical backwater areas. A prime example of backwater rejuvenation has been accomplished in Pool 5A in 1978, when the Corps, cooperating with GREAT I, constructed three aeration culverts through the dike of Lock and Dam No. 5 to provide consistent flow into the stagnant backwaters of Upper Pool 5A, commonly called Fountain City Bay area. Since then, over 5,000 acres of marshes, swamps and sloughs have received fresh flows providing life-giving oxygen which have been relatively free of sediment (FWWG I, 1979). Similar rehabilitative measures are needed for backwater areas which have become isolated from main channel water flows. One such area, Burnt Pocket in Pool 18, has since impoundment been accumulating sediment and nutrients causing overvegetation and stagnation. In an effort to alleviate this problem, a water diversion channel has been constructed to divert water into this backwater to scour fine sediments, reduce vegetational growth and provide fresh oxygen supplies. Three such side channel openings in Pools 2-6 have been constructed at the request of the GREAT I Fish and Wildlife Work Group. Background data (sediment size, DO, temperature, benthos, etc.) has been collected at these sites, as well as Burnt Pocket, so that response parameters can be compared with pre-opening conditions. In addition, a side channel opening response model (Claflin, 1979) is being tested in order to develop an accurate predictive tool for backwater management. (See SCWG II Appendix for detailed discussion of this project.)

Certain habitat mitigation/enhancement measures can be designed to not only benefit fish and wildlife but also accomplish other benefits. The FWMWG has contracted studies (Classification of Channel Training Structures and Wing Dam Modification) to determine how wing dams can be constructed to provide maximum benefit to fish and wildlife and at the same time perform maximum hydraulic efficiency functions. Such studies will provide valuable information as to structural use requirements for fish and other aquatic organisms. Information should also be gained showing design requirements which will alleviate sediment yield to backwaters and side channels, induce bed scour in historic dredging areas and cause sediment accumulation at areas where economical and environmentally sound dredging and disposal operations can take place.

Levee construction projects can also be designed to perform dual-purpose benefits. The Fulton Flood Protection Project in Pool 13 will be constructed utilizing dredged material obtained from backwater sloughs adjacent to the project. Extracting borrow material from the backwater sloughs will not only meet the prime engineering objective of obtaining levee material but also will meet a secondary biological objective of improving fish and wildlife habitat. Up to several feet of silt overburden must be removed from the sloughs before the sand, needed for levee construction, can be obtained. As presently proposed, the silt overburden will be deposited on low slough islands to raise their elevations 5 to 6 feet. It is considered that the increased elevation will allow the establishment of more diverse, productive wildlife habitat. In the process of dredging, the shallow sloughs will be deepened and subsequently improved for fish.

In 1975, a levee was constructed at Buffalo City, Wisconsin, to provide flood protection. The project entailed raising and widening a county highway using dredged material for fill. The material was obtained from a filled-in side channel that previously provided recreational craft access to the river. The project, in addition to these economic benefits, demonstrated the feasibility of using off-channel dredging equipment (Mudcat) which can be used in an environmentally-sound manner for backwater management projects.

These examples display some of the alternatives available to reduce the environmental and economic impacts on accumulating sediments throughout the river corridor. Because sedimentation has just recently been recognized as a prevalent problem, these methods and additional test cases need further documentation and more widespread implementation in order to determine the short and long term effectiveness of rehabilitation/protection measures.

To insure long term continuation of the unique fish and wildlife resource of the Upper Mississippi River, the source of the problem, that is upland and streambank erosion, must be recognized and corrected.

The Sediment and Erosion Work Group, GREAT I (SEWG I) evaluated the cost and benefits of increasing the effectiveness of existing sediment control measures to reduce soil loss. Their findings indicated that with current land treatment practices, the outside possibility for soil loss reduction is approximately a 50 percent reduction (40 million to 20 million tons per year) in soil loss.

Because existing treatment measures are able to reduce erosion only by one-half, new, more intensive erosion control practices need to be implemented.

Conservation tillage methods which should be examined as potential adequate land treatment alternatives include no-till planting, residue management, terracing and contouring (SEWG II, 1980). A "high vegetative practice" program (a combination of these four alternatives) has been identified by GREAT II (SEWG II, 1980) as the most effective and economical land treatment option for reducing cropland erosion to tolerable levels. Herbicide use, and their ultimate input and impact on the river environment could be reduced by proper sequence planting and by planting selected row crops that can compete with weed species. Pesticide use may increase, but the magnitude of their impacts are unknown. No-till farming does reduce the amount of energy required to run farm machinery, since there is little or no plowing, harrowing or cultivating. No-till farming also enables farmers to get on their land earlier in the spring for planting, because sod is not as slippery or soft as bare ground. In addition, ground cover holds water, soil and soil nutrients, rather than allowing all three to run rapidly into tributary streams and hence into the river. Implementation of the "high vegetative practice" program at critical areas would probably require federal funding (U.S.D.A.) because of high implementation costs and potential yield reductions (cost sharing program). Technical assistance would be coordinated with state and county conservation agencies.

In highly productive soils, vegetation has been removed up to the streambank to allow for additional acres to be cultivated. This practice significantly increases streambank erosion. Control of streambank erosion at tributaries in the GREAT II area have been limited to relatively minor bank stabilization efforts by the Corps of Engineers. Some farmers have protected riparian areas by establishing greenbelts adjacent to streams and grass-waterways in drainage ways. While the benefits of extensive bank protection programs would certainly help reduce sediment input, dredging requirements and disposal (and secondary movement) impacts on fish and wildlife; the thrust of sedimentation control measures should be placed on curtailing upland erosion. Presently, the most effective method for dealing with coarse sediment accumulation in the UMR is to perform dredging activities so that operational and disposal impacts are minimized. Further study to identify critical bank erosion areas and the merits of implementing protective measures must be assessed before determining how to address this issue.

II. C. OPERATION AND MAINTENANCE OF THE NAVIGATION CHANNEL

Since the River and Harbor Act of 1878, the establishment, operation and maintenance of the Upper Mississippi Waterway has been assigned to the U.S. Army Corps of Engineers. Methods employed by the Corps to maintain navigation, particularly during low flow periods, included sediment removal, diking, revetment and wing dam construction.

Subsequent congressional direction culminated in the present 9-foot navigation project on the Upper Mississippi River. This project was originally made possible by the construction of a system of 29 locks and dams which maintained controlled pool water levels and by dredging. The purpose of the project is to provide for continued commercial and recreational navigation for a 866 mile stretch of the river.

The GREAT II study area includes twelve lock and dam created "pools" in the middle portion of the Upper Mississippi River over a 315 mile stretch. The dredging aspect of the 9-foot channel project involves removal of main channel sediments to maintain channel depth. Current navigation channel operation and maintenance practices have adversely affected fish and wildlife resources in a variety of ways as noted below.

II. C. 1. Maintenance Dredging Impacts

Despite pool level control at locks and dams and river hydraulics "training" structures such as wing dams, closing dams and dikes, sediments entering the main channel from tributaries tend to accumulate in the main channel or backwaters as a function of sediment particle size and flow velocity (Simons, et al., 1975). Coarse sand sediments normally (during normal flow conditions) are confined to the main channel and accumulate at areas where lower flows allow them to settle. Such conditions necessitate dredging to maintain the navigation channel.

The dredging operation causes damage by removal of localized benthic organisms during the excavation (Hirsch, Di Salvo, Peddicord, 1978). This occurs during both hydraulic (COE Dredge W.A. Thompson-Figure 4) and mechanical (COE Dredge Hauser) dredging. Disruption of local materials causes suspension of sediments within the water column. Experiments performed at the U.S. Waterways Experiment Station (WES) as part of the Corps of Engineers Dredged Materials Research Program concluded that concentrations of sediment suspended during dredging are generally non-toxic and of short duration (Hirsch, et al., 1978). However, more study is needed to be sure that this generalization is correct for all aquatic environments and geographic locations. During dredging, the potential for release of contaminanted sediment increases the potential for adverse impact on aquatic organisms by heavy metal uptake, fluff coverage, oxygen depletion and reduced photosynthesis (Hirsch, et. al., 1978).

Some dredged material disposal practices by the Corps have had catastrophic impact on fish and wildlife resources, both directly and indirectly. Direct coverage of main channel border (Figure 5), side channel and backwater habitat has buried terrestrial and aquatic organisms and sterilized biologically productive acreage (i.e. Snipe Island, RM 424.5 L; side channel adjacent to Bluff Slough RM 510.5 and side channel adjacent to Little LaGrange Island RM 339.0-339.6).

A review of Illinois Department of Conservation electro-fish sampling data has indicated a significant decrease in species and numbers at dredged material disposal sites adjacent to the main channel border when compared to main channel border sampling locations at non-disposal sites. Fifteen species were collected at the sampling locations adjacent to spoil sites; whereas, 21 species were collected at non-disposal locations. Table 4 shows comparative catch per unit effort for representative species at these sampling locations. Although use of this

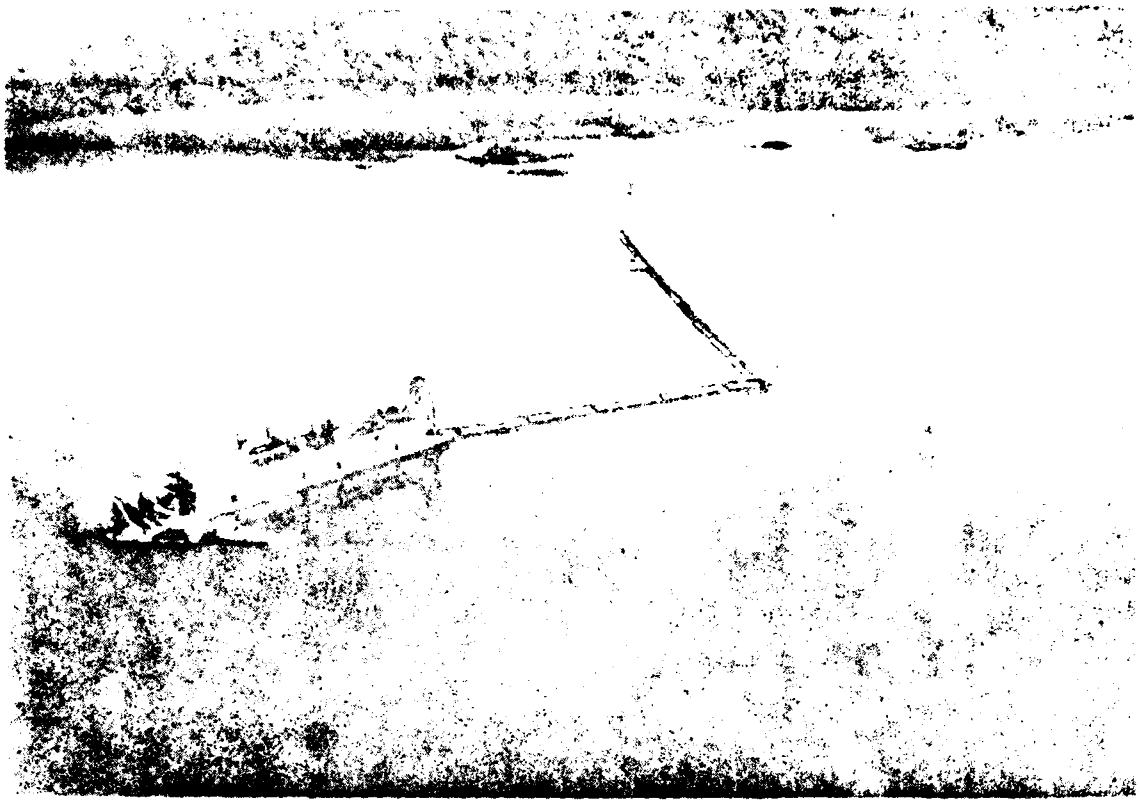
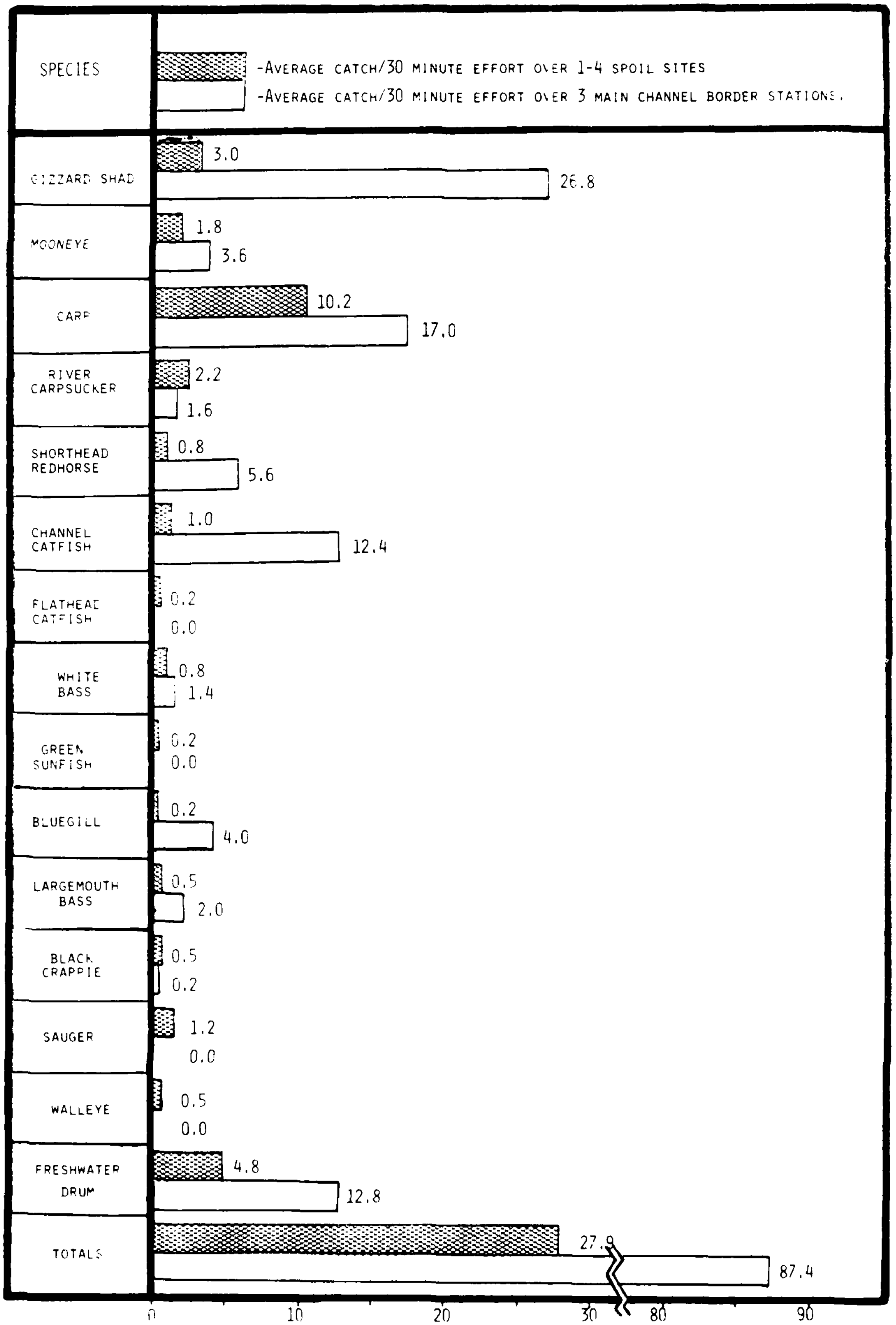


Figure 4. Dredge W.A. THOMPSON in operation.

Figure 5. Open water disposal of dredged material near Cordova, Illinois (RM 504).

TABLE 4 . COMPARISON OF CATCH/30 MINUTE EFFORT OF SELECTED FISH SPECIES OVER MAIN CHANNEL BORDER AND DREDGED MATERIAL SITES.



data is severely limited by sampling techniques, it does demonstrate that the main channel border habitat value has been decreased by dredged material disposal.

Interpretation of historic and recent aerial photographs (SCWG II, 1980) revealed 1,800 acres of aquatic habitat impacted by disposal of dredge spoils between 1956 and 1975. Disposal of material in terrestrial areas was not estimated due to difficulties in interpretation through vegetation.

In the main channel area, which is dominated by shifting sand substrate, channel structures provide habitat diversity and stability which increase productivity. Coverage of these structures reduces this productivity and can increase dredging requirements by preventing effective sediment transport. Effluent discharge from hydraulic disposal operations causes turbidity and can cause release of toxic materials if contained in the dredged sediment (Burks and Engler, 1978). Dispersion of disposed dredged material, particularly during high flow periods (spring flooding) has caused closure at side channels and sloughs which provide flow to backwater areas (i.e. Goetz Slough, RM 612.5 R). The result is isolation of valuable backwater areas causing, among other impacts, decreased dissolved oxygen levels and increased sedimentation. This effect has displaced desired productivity and had generally caused accelerated ecological succession in aquatic habitats (FWWG I, 1979).

Agencies responsible for fish and wildlife resources along the Mississippi River have long been concerned with the problems associated with dredge spoil deposition and have expended a substantial amount of time and effort to minimize impacts.

Several documents (Anonymous, 1963; Robinson, 1970) were written and submitted to the Corps of Engineers by the fish and wildlife agencies, which recommended general areas for disposal of material. These areas were considered to be the "least destructive sites" considering the equipment limitations of the Corps of Engineers-Rock Island District (COE-RID). Beginning in the late 60's, annual meetings were held with the Corps of Engineers to provide personnel from fish and wildlife agencies an opportunity to comment on dredging proposed for the upcoming year. Primarily, the comments consisted of the locations of sites which would result in the least destructive impacts. Major problem areas were reviewed on-site.

With the advent of GREAT, an on-site inspection team (OSIT) was developed to more effectively deal with site specific dredge material problems. The intent was greater coordination of input from river biologists into the Corps of Engineers dredged material disposal decisions.

In GREAT II, the OSIT has evolved one step further such that the OSIT consisted of chairmen of each GREAT II work group. The intent is greater coordination of input of all interest groups into the Corps dredged material disposal decisions. In addition,

GREAT II is developing a channel maintenance plan. (The reader is referred to the Activities and Accomplishments Section for a discussion of the work group's participation and comments on this endeavor and Appendix 23).

Throughout development of the plan, the concern of river biologists has been in all instances that the site selected for disposal has had to be the site which is "least" destructive to fish and wildlife resources. In most cases impacts to fish and wildlife resources at the "selected site" were almost as significant as impacts would have been if material was placed at any other site.

The selection of these sites is tied to the equipment capabilities of the Corps. The Corps has not acquired such equipment, since without authority and funding they cannot acquire the equipment necessary to place material in areas which would significantly reduce impacts on fish and wildlife.

II. C. 2. Water Level Manipulation

Lock and dam construction in the 1930's dramatically changed the character of the Upper Mississippi River. Thousands of floodplain wetlands, lowlands and forests were inundated by the created river-reservoir system. While the initial effect on fish and wildlife was generally highly beneficial, some organisms suffered dramatic of complete loss. Vast backwater areas with relatively stable water levels replaced seasonally flooded marshes, bogs and lowlands. Fishery and wildlife productivity were greatly enhanced by the creation of these pools.

During critical spawning, nesting, feeding, migration and other periods of life cycles, fish, wildlife and flora can be drastically affected by sudden fluctuating water levels. Natural rises in pool levels and manipulation of pool levels to maintain commercial tow passage can expose and destroy benthic and flora colonies which are primary food sources for fish, waterfowl and furbearers. Additional adverse impacts include island inundation during waterfowl nesting, furbearer nest exposure or inundation during critical times, vegetation coverage causing increased wave action and turbidity, exposed erodible shorelines and an inconsistent littoral zone.

Despite these potential impacts, water level manipulation can be extremely beneficial if managed considering fish and wildlife purposes. This would entail comprehensive evaluation of fish, wildlife and aquatic vegetation seasonal stress periods. Management of water levels can be used to facilitate management of fish

and wildlife resources by controlled vegetational growth, fish access to spawning areas, island isolation from disturbance (man, predator, etc.) access to waterfowl nesting, and maximization of littoral zone productivity (FWWG I, 1979). Equally important is the management potential that water level manipulation has to control undesirable biological productivity such as overvegetation (Benson, 1969). The work group recommended manipulation of water levels in Pool 16 to improve habitat (refer to Activities and Accomplishments Section). Weather conditions did not permit implementation of the program.

Pool level control is presently separately managed by Corps Districts (St. Paul, Rock Island, St. Louis) of the Upper Mississippi River. Because each district manages pool levels independently, those pools at bordering districts are prone to more extreme fluctuations.

II. C. 3. Habitat Enhancement

As stated earlier, valuable fish and wildlife habitat has been decimated by man's multipurpose pressure on the resources. This decline will continue unless man's encroachment is reduced significantly. This undoubtedly will not occur. Agencies responsible for management purposes on the Upper Mississippi River must commit themselves to improving environmental quality of existing fish and wildlife habitat as best they can. Sometimes, however, even their hands are tied. Implementation of enhancement/rehabilitation projects are presently limited because of agencies' policy and law. For instance, present Corps authority to maintain the navigation channel does not include consideration of fish and wildlife as part of the 9-foot channel project purpose. Present Corps authority for backwater management is limited to actions which will increase the efficiency of the navigation channel. If authorized to include fish and wildlife as a purpose, new techniques, such as wing dam notching or backwater dredging, could be implemented during operation and maintenance activities that would enhance fish and wildlife.

As mentioned before, numerous methods (flood levees, culverts, wing dams) are available which could be used for enhancement purposes. The development of habitat or alteration of existing conditions must undergo comprehensive planning analysis so that decisions can be made as to species to manage for, and only then should implementation take place. Because physical and biological responses of habitat alteration can be of enormous magnitude and effect, monitoring programs are necessary to record background conditions and to compare this data with after-change affects.

II. C. 4. Structural Channel Control and Protection

Levees, wing dams, closing dams, riprapped shorelines and other structures serve to control erosion or train flows. In addition, they have value to fish and wildlife by adding habitat diversity to the main channel area which is dominated by sand covered habitat. This type of habitat has been shown to increase main channel productivity by providing substrate for periphyton and benthos (Hynes, 1970; Kallemeyn and Novotny, 1977; Lovejoy and Kennedy, 1979).

The Wisconsin Department of Natural Resources assessed fish utilization of sand, submergent wing dams and riprapped shorelines in the Upper Mississippi River by night electroshocking. Results of that study showed riprapped shoreline was the preferred habitat (Mississippi River Work Unit, 1978). A second study in 1979, winter catfish observations by SCUBA, showed catfish densities were highest along riprapped shorelines (250-650 fish/acre) and immediately downstream of submerged wing dams (1450 fish/acre). Very few fish were seen where rock substrate was absent (WI DNR, 1979). Similar relationships of habitat and species use and diversity hold true for fresh water mussels (Harmon, 1972; Fuller, 1978).

In the Middle River (below Lock and Dam 26), Funk and Robinson (1974) have found emergent wing dams, and closing dams to be very detrimental to river systems as they almost always fill in with sediment, resulting in loss of valuable habitat (Lovejoy and Kennedy, 1979).

Despite the benefits some of these structures have for aquatic animals, overuse of such structures would cause channelization which significantly impacts the fishery (Lund, 1976; Frasier and Gray, 1976; Sport Fishing Institute, 1971; Schneeberger and Funk, 1971).

II. C. 5. Extended Navigation Season

As the extent of navigation begins to reach its carrying capacity during winter months, the pressure for extension of navigation into the winter months will be increased. The extension of the navigation season into the environmentally sensitive winter period has the potential for many adverse environmental impacts. It is known that adverse effects of physical impacts associated with navigation are intensified by winter conditions and by the increased physiological stress incurred by river organisms during periods of colder temperatures.

The navigation season is presently controlled primarily by economics if the financial conditions are such that a barge company can operate profitably under the adverse winter conditions, then they will navigate through the ice. Historically, winter operation has not been cost effective to barge companies due to increased damage to equipment, increased fuel consumption and reduced tow size when operating in ice. As future demands on the river for movement of products increases, demands for expanded navigation, which includes an extended navigation season, will also increase. A system for controlling the navigation season needs to be designed to consider not only economic conditions but also winter conditions, environmental conditions, river conditions, and safety.

The physical impacts that will occur as a result of winter navigation are propeller damage, broken ice in the channel, barge noise and movement, wave action and water displacement, physical disruption of the river bottom, resuspension of sediments, and bubbler system aeration. Other physical impacts that may potentially occur are changes in frequency of ice jams changes in frequency of spills, release of sediment-bound toxicants, increased noise in the river corridor and changes in water quality.

Since the extent and degree of physical impacts resulting from winter navigation and the winter biology of Mississippi River organisms are almost completely unknown, environmental investigations are needed to assess environmental impacts which may result from extension of the navigation season.

II. D. DISTRIBUTION AND ABUNDANCE OF FISH AND WILDLIFE

Many lands and waters on the river are identified as fish and wildlife management areas and are managed by Federal and State resource agencies. Other lands and waters on the river provide an immense resource of great value to fish and wildlife populations.

Fish and Wildlife resources have been, and continue to be, threatened by competing resource uses including industry, navigation, agriculture, recreation and municipal interests. Balancing these resource uses with fish and wildlife concerns is a major challenge which calls for coordinated, and complete planning for fish and wildlife resources.

A wealth of information is available on the distribution, abundance, population characteristics, and harvest of fish and wildlife resources of the Upper Mississippi River. The value of much of that information for use in management decision-making processes is greatly limited, however, for various reasons. With an ever-changing river

environment, information previously collected on the distribution, abundance, population characteristics, and harvest of fish and wildlife resources may not be applicable to present condition. Much of the information available concentrates on a relatively few species of significant sport or commercial value. Nearly all of the information is collected for specific sites or areas. The ability to integrate information and apply it to the biological system as a whole is severely limited by incongruities in sampling methods, data analysis, intermittent nature and seasonal differences in data collection and the difficulty in consolidating data assembled by various agencies over an extensive area. Further, management of this system, the responsibility of which is shared by many agencies, is hampered by a lack of authority to initiate land management planning, lack of continuity in planning and implementation and lack of funds.

To acquire the needed biological information base for current management decisions, additional data is needed on the distribution, abundance, population characteristics, and harvest of many species important to the river's biological system as a whole. Voids exist in the knowledge available on major species which have been studied. Many more species, important as forage, indicators, or non-game species, have not been studied at all.

This type of base line information, as well as studies to up-date the current data base, must be collected on a systematic and coordinated basis to permit integration and expansion of the data over the river as a whole. A delineation of data needs and specific sampling objectives is necessary for the river system. Certain standardization of sampling gear between agencies has been accomplished through the Upper Mississippi River Conservation Committee. But additional standardization of methods, data analysis, sampling frequency, and timing is also needed to make data comparable. Further, centralization of data in a manner which can be readily retrievable and updated is essential.

Pool 19 (Keokuk Pool) of the UMR is the most important inland area for diving ducks in North America. Diving ducks depend heavily on Pool 19's rich supply of benthic organisms (primarily fingernail clams) for a source of food during the fall and spring migration. However, chemical and ecological parameters indicate that the Pool is in trouble ecologically and may be on the brink of collapse as an ecosystem.

Pool 19 is the oldest and longest of the pools, covering over 46 miles and 30,000 acres. Multiple demands for its use include the generation of hydroelectric power, commercial navigation, sport and commercial fishing, hunting and trapping, recreational boating and swimming, and municipal and industrial water supply among others. Management of Pool 19 for fish and wildlife becomes

increasingly difficult as these various demands increase, and is compounded by private ownership of nearly all the adjoining land areas and submergent lands. Piecemeal development and impacts by private citizens, industry, and municipalities are having a cumulative effect which must be more closely monitored and regulated to ensure protection of fish and wildlife resources.

Management strategies are available, and some have been recommended to enhance Pool 19 for specific components of the fish and wildlife community and their utilization. However, there is a need to coordinate these various strategies and management objectives between the agencies and interests involved for proper management of the fish and wildlife resources as a whole. This comprehensive management plan for the fish and wildlife resources of Pool 19 is needed to enhance those resources and to better protect them from adverse impacts on encroachment, development, hazardous spills and other demands.

II. E. HABITAT ALTERATION

Off channel areas of the UMR provide the diverse habitats which make a unique and highly productive fish and wildlife domain. Natural and impoundment backwaters and wetlands support exceptional vegetational growth which plays a vital role in life functions of fish, waterfowl and furbearers. Intricate networks of sloughs and side channels connect these backwater lakes and ponds, and are essential as a renewable supply of dissolved oxygen to support productivity.

Impoundment was responsible for the creation of much of the productive marsh and aquatic habitat. However, natural forces cannot support the continued existence of the new configuration. The reduced ability of the river to transport incoming sediments downstream (FWWG I, 1979), causes sediment to be trapped in backwaters and lower pool areas. Historically, some indiscriminate dredged spoil placement practices (and secondary movement of this material) by the Corps have intensified the sedimentation problem by closing off side channels and sloughs (SCWG) and, thereby, isolating the off-channel areas from fresh flow oxygenation (Corps 9-foot EIS, 1974) and sediment flushing effects. The cumulative impact of sedimentation has accelerated ecological succession of aquatic habitats, resulting in losses of water surface area and volume and fish and wildlife habitat decline.

To reduce the rate of sedimentation or, where appropriate, rejuvenate backwaters, physical alteration of existing structures, habitat and/or modification of new structure is necessary.

Through the GREAT I and GREAT II SCWG, river biologists have identified numerous side channels and backwaters which are lost or being lost through sedimentation.

One approach to rejuvenating such areas has been the construction of an opening or a cut into an isolated area. For example, a side channel was constructed into an isolated backwater (Burnt Pocket, RM 422.6 L) to provide a continual flow. In some, an existing side channel may require partial closing in order to preserve the backwater. In Pool 5A, a partial closing dam was constructed at the entrance of Devil's Cut to reduce the amount of coarse sediment being transported to the backwater.

As a result of the studies mentioned above and others, the biological and hydrological consequence of altering backwaters is becoming better understood. While the success of these studies should stimulate additional actions to improve backwater habitat, further studies must be made at other openings before all the ramifications of these actions are known.

Under authorization to maintain the navigability of the Mississippi River, the Corps of Engineers has constructed wing dams to divert the river's flow. It is the general opinion of resource managers that submerged wing dams can be valuable to aquatic organisms.

As existing natural habitat becomes more scarce, it becomes increasingly important that we investigate and understand what values man-made structures (such as wing dams) afford fish and wildlife resources. Further methods to construct or alter these structures to optimize their benefit to fish and wildlife need to be developed.

II. F. ENCROACHMENT - INDUSTRIAL, MUNICIPAL, AGRICULTURAL, RECREATIONAL

The value of the river can be measured by the many uses man demands of its waters, its shorelines, and its floodplain. Population expansion in the Upper Midwest has historically bordered the river because of its easy transportation opportunity for man and his products. Today, the river acts as the main artery of human life through the nation's heartland.

The impacts of land conversion (Figure 6) on fish and wildlife are loss of natural habitat, development on shoreline ecotones, pollution via industrial and urban run-off point sources, magnified non-point pollution by reduction of erosion retardant forest and pasturelands, increased sedimentation, increased air pollution, increased recreational use and requirements, increased leveeing of the floodplain and corresponding increases in flood heights (Figure 7), active disturbance of natural areas and fish and wildlife natural functions. Traditionally, as man and his developed community advances, the size and quality

Figure 6. Filling of river for industrial purposes (Pool 19).

Figure 7. Levee construction at Clinton, Iowa.

of the natural environment declines. Wetlands are being drained to accommodate agricultural needs. Agricultural lands are being converted to developed areas. Commercial and economic growth demand expansion of navigation facilities.

Because of concentrated human populations, open space land adjacent to established urban areas will, as in the past, be subjected to conversion into urban land uses. The U.S. Department of Agriculture predicts that approximately 21 square miles (82 square kilometers) of open space acreage in the GREAT II area will, under current land use conversion rates, be developed into urban and build-up areas by the year 2000 (UMRBC 1979). Additional forecasts expect an increase of 607 square miles for pasture and 103 square miles for forest. On the basis of these anticipated land use requirements, it is evident that increased encroachment on fish and wildlife habitat is forthcoming.

The SCWG II assessed land use changes between 1956 and 1975 by aerial photograph interpretation and found that 514 acres of woodlands have been converted to agricultural land, 1648 acres of agricultural land have been converted to developed areas, and 480 acres of woodland have been converted to developed areas.

Federal lands which have been designated as fish and wildlife refuges (i.e. Upper Mississippi River Wild Life and Fish Refuge and Mark Twain National Wildlife Refuge) have not been spared this advancement of man. Approximately 1,000 acres of refuge land have been covered with dredge spoil material. Dredge spoil disposal practices of the COE have not only destroyed valuable fish and wildlife terrestrial and aquatic habitat, but have also created beach areas which invite recreational uses which are non-wildlife oriented. Intrusion into designated refuges not only disturbs the calendar of natural events, it usually includes the scars of man's use in terms of damaged vegetation and garbage remains. The U.S. Fish and Wildlife Service policy is to phase out and/or discourage non-wildlife recreation on refuge lands. Off-refuge recreational areas should be established where they would have the least disturbance on fish and wildlife habitat.

Today, the majority of habitat lost to encroachment is done on a piecemeal basis. An excellent description of this process provided by Panek (1979) follows:

Small habitat modifications are easily overlooked because of their individual size and priority when compared to many larger matters that are dealt with by resource management agencies on a daily basis. A small habitat modification generally results in a minimal change in the structure, stability and/or productivity of an aquatic or terrestrial ecosystem. What may constitute a small habitat modification in one ecosystem may represent a substantial modification in another. By the very nature of the problem it is difficult, if not impossible, to quantify a small habitat modification. It is usually only after the fact that we perceive the cumulative impact of numerous small habitat modifications.

Small habitat modifications include small-scale dredge and fill activities, sand and gravel removal from streambeds, drain ditch runoff, agricultural [illegible] runoff, wetland and marsh mosquito ditching, roadbuilding, non-point sources of urban storm water runoff, highway salting and runoff, [illegible] spills resulting from fueling operations, [illegible], highway accidents, etc. Other examples include construction of docks and piers, rip-rap, dikes, water [illegible], [illegible] and numerous small, largely unregulated construction and industrial activities.

Presently, very little quantitative biological information exists on the effects of various small habitat modifications on aquatic and terrestrial communities and in particular on wildlife or fisheries production. The lack of data on cumulative, synergistic, and/or antagonistic effects makes prediction of change difficult at the present time. The fact that these changes occur is evident, although difficult to quantify, and should be important considerations in natural resource planning.

Since the strength of wild organisms is dependent on the quality and quantity of its habitat, man's growth is leading the natural environment and its inhabitants to an unnatural death. Future planners must include fish and wildlife and habitat quality protection as a primary objective of land use management, or the cumulative effects of encroachment will ultimately destroy the environmental value of the Upper Mississippi River.

II. G. WATER QUALITY

Degradation of the quality of Mississippi River waters is closely associated to the advancing encroachment of man in the UMR basin. Expansion of industry, the demands of municipalities and agriculture and recreation have adversely affected water quality. Industrial intake/output water use results in point source discharges which alter water chemistry and temperature. Municipal wastewater discharge facilities are inadequate to contain water quality parameters above recommended use standards (UMRBC Main Stem Level B, 1979). Conversion of vegetated pasture and forest lands to cropland has accelerated water run-off causing more severe erosion and larger sediment yield into the river. Cumulative water quality effects from these multiple pollution sources include higher water temperatures, decreased dissolved oxygen content by heavy metal uptake, increased organic compound content in sediments and the water column, increased biochemical oxygen demand, increased turbidity, and higher sedimentation rates.

Dissolved gases, in the water, are subjected to foreign chemicals, causing reactions which can deplete desired dissolved oxygen

content and increase the concentration of dissolved toxic compounds. Such occurrences interfere with respiration and reproduction activities of aquatic organisms. Organic compounds, such as DDT and PCB's, bioaccumulate in aquatic animals, causing potential health hazards when these organisms are harvested for human consumption. The same is true of heavy metals such as mercury and zinc.

Fish and wildlife resources are susceptible to these pollutants. Backwater areas are becoming eutrophic due to sediment accreation and increased nutrient load from municipal and industrial discharges (SCWG I, 1979).

Changes in water quality can ultimately impact fish and wildlife over extensive aquatic areas. The construction of locks and dams, while causing an increase in productive backwater areas, decreased the habitat diversity of the UMR. The result was the development of pool "ecosystems" with a more simplified system. This type of community is subject to drastic changes in short time periods. Water quality changes could cause such dramatic circumstances. Introduction of certain pollutants can abruptly affect vegetation or benthic organism production. A break like this in the biological food chain could cause significant damage to higher life forms.

Fingernail clam production has mysteriously declined in Pool 19, the probable cause being water chemistry changes from pollution. The reduced fingernail clam production poses severe consequences for waterfowl during migration. This pool has been described as the single most important diving duck habitat in North America. The fingernail clam is the primary food source for the diving ducks of this pool.

The advent of increased navigation on the UMR further jeopardizes the water quality which is so vital to aquatic organisms. Impacts such as turbidity and accidental spill incidence will undoubtedly cause further damage to aquatic organisms and habitat. Due to increased transport of toxic materials (i.e. fuel products, chemicals) by both barge and railroad industries, the chances of an accident affecting fish and wildlife will continue to increase. Present day technology for hazardous spills is not sufficient to effectively handle clean-up on high velocity rivers, such as the UMR. Further, clean-up of such spills would be extremely difficult during winter, and damage to the environment could reach catastrophic proportions.

II. H. Boat Traffic

II. H. 1. Commercial

As the 9-foot channel project greatly increased commercial navigation of the UMR, it also increased the potential for environmental

damage to occur. The navigation channel and the maintenance dredging it demands have played a major role in prompting succession of open water backwaters to terrestrial habitat by causing hydraulic isolation of off channel areas at certain locations. These backwaters have been exposed to constantly changing flow conditions due to dredge spoil placement, structural manipulation and pool level control, prompting vegetational changes. This susceptibility to change, particularly in these fragile backwaters, threatens habitat stability, a desired condition for fish and wildlife species density and diversity (Odum, 1971).

Physical impacts of commercial navigation play a role in habitat decline as well as adversely affecting water quality. The movement of the towboat props has been shown to increase turbidity in the water column by resuspending bottom sediments (Karaki and Van Hoften, 1974). Impacts from turbidity plumes include respiratory damage to aquatic organisms, food concealment, retardation of the photosynthetic process, decreased plant oxygen production and interference with reproduction cycles (SCWG I, 1979). Claflin (1976) has shown that turbidity effects of tow passage can reach far into side channels and backwaters.

In addition to prop wash effects on bottom sediments causing turbidity, wave action on shorelines caused by barge tow passage induces erosion on unstable banks. This causes increased sediment production and turbidity impacts.

Because of the increase in commercial navigation, expanded support facilities have been necessary. Included among these demands are lockage waiting areas, greatly expanded fleeting area requirements, and urban port area development, including barge terminals and docks. All these expansion requirements have necessitated conversion of or damage to aquatic shorelines. Along with habitat conversion and channel widening impacts, this commerce expansion has damaged main channel border shoreline "ecotones" and bottomland trees due to tie-offs, and has increased erosion.

Tow passage also causes disruption of natural conditions prompting fish and wildlife alarm response. This is particularly evident by hazing effects on waterfowl during migration.

With increased barge movement on the UMR, the potential for accidents also increases. Shipment of hazardous materials by this transportation mode poses the most immediate threat on fish and wildlife.

The concept of expanding commercial utilization of the Upper Mississippi Waterway either by depth of channel or length of the navigation season would cause further decimation to fish and wildlife.

Increased depth would expand dredging and spoil disposal requirements. Winter navigation would increase damaging spill incidence because of barge hull punctures from ice fragments. Fish populations, generally more lethargic because of colder water temperatures and forced to congregate in the deeper, more highly oxygenated main channel area, would be highly vulnerable to destruction by prop damage and ice movements. Overwintering reptiles, amphibians, and aquatic mammals could be exposed by fluctuations in water levels or buried by shifting sediment caused by tow displacement of water. Increased turbulence due to tow prop wash could cause increases in turbidity, which would lower water quality and adversely affect aquatic organisms (Midwest Research Institute, 1977).

II. H. 2. Recreational

Increases in population, income and leisure time have tremendously increased recreational utilization of the Upper Mississippi River. It is anticipated that this demand will continue to show significant increases (UMRBC Main Stem Level B, 1979). It is expected that recreational boat traffic should increase as demand increases.

While pleasure boaters are anxious to enjoy the recreational opportunities the river has to offer, they have little knowledge of the adverse effects they have on the fish and wildlife habitats they use for their recreational experience. Prop and wave wash effects, like those of towboats, induce turbidity and shoreline erosion. Pleasure boats are not confined to the main channel, however, and the sediments they resuspend from side channels, sloughs and backwaters are generally finer and remain in suspension for longer time periods. Because fish and aquatic organism production is greater in these lower flow habitats, more damage is caused by this resuspension of sediment.

Increased speed of pleasure craft, when compared to tows, creates greater wave turbulence on shorelines, which accelerates erosion of unstable banks and again results in increased turbidity (Karaki and VanHoften, 1974). In general increased speed and resulting wave turbulence causes disturbance and/or disruption of resting and feeding activities of all wildlife.

Pleasure boaters cause disturbance to resting and feeding waterfowl. During the fall migration, this boating activity moves waterfowl and subjects them to increased hunting pressure. This problem is most profound in heavily used duck feeding areas.

III. FISH AND WILDLIFE RESOURCES - BASE CONDITIONS

III. A. AQUATIC RESOURCES

III. A. 1. Aquatic Habitat

The aquatic resources inhabiting the Upper Mississippi River (UMR) are, as in most waterbodies, a function of the habitat available. The UMR offers a variety of habitat, classified into six categories by the Upper Mississippi River Conservation Commission (UMRCC).

The acreage quoted for habitat types have been summarized from the "Upper Mississippi River Habitat Inventory" (Hagen, Werth and Meyer, 1977). Acreages noted for the main channel in the inventory include main channel border habitat. To provide an acreage figure for both of these habitats, it was assumed the main channel habitat (i.e. navigation channel) has an average width of 450 feet. The inventory's description of lakes, ponds, sloughs and sidestreams do not correspond well enough with the UMRCC habitat description to assign them specific acreages. However, the area encompassed by the habitat types in both descriptions is the same (i.e. all off-channel area with the exception of side channels and the main channel border). For purpose of this report, these acreages were summed and noted under the section entitled River Lakes and Ponds.

River Lakes and Ponds -- As noted above, the acreage of this type of habitat and sloughs and streams were summed for a total of 59,200 acres in the study area. These areas have been broadly referred to as "backwaters" and are often connected with the river at normal river stages. These waters represent lakes formed by both artificial impoundments and natural dams or dikes, isolated oxbows or meanders, and natural depressions. However, the greatest acreage of backwaters was created by the locks and dams.

Physical characteristics of the backwater areas include little or no flow, relatively shallow depths, and a bottom layer of silt and sand two or more feet thick. Backwaters vary in size from several acres up to thousands of acres. The vegetation diversity of backwaters is exceptional. It is not unusual to find more than two dozen species in a relatively small area.

Side Channels -- These include all departures from the main channel and main channel border in which there is current during normal river stage. Side channels typically occur

in the upper and middle pool zones. There are approximately 3,500 acres of this habitat type in the study area. The graduations in this category are widespread, ranging from fast flowing watercourses with banks to sluggish streams winding through marshy areas. Unless they are former main channels, the banks are usually unprotected. Undercut or eroded banks are common along the side channels near their departure from the main channel. This occurs mainly in the upper sections of the pools where banks are highest and the current is swifter. Closing or diversion dams are sometimes present where the side channel leaves the main channel or main channel border. These structures are mostly submerged. The bottom type usually varies from sand in the upper reaches to silt in the lower. In the swifter current there is no rooted aquatic vegetation, but vegetation is common in the shallower areas having silty bottoms and moderate to slight current (Nord, 1967).

Sloughs and Side Streams -- The slough and side stream habitat category borders the river lake and ponds and side channel habitat Their acreage is a portion of the 59,200 acres identified for river lakes and ponds. Sloughs are relatively narrow branches or offshoots of other bodies of water. They are characterized by having little or no current at normal water stage, sand bottoms, and an abundance of submerged and emergent aquatic vegetation. Many sloughs are former side channels that have been cut off by sedimentation or deposition of dredge material. Side streams as identified by Hagen et al are mainly small tributaries entering the river.

Sloughs, side streams, and some of the ponds and smaller lakes are most representative of the ecological succession taking place in the river bottoms, from aquatic to marsh habitat.

Main Channel -- This includes only the portion of the river through which the large commercial craft can operate. There are approximately 17,100 acres of this habitat type in the study area. It is defined by combinations of various channel control structures, natural features, and navigation markers. It has a minimum depth of nine feet and a minimum width of 300 feet. A current always exists, varying in velocity with water stages. The bottom type is mostly a function of current. The upper section usually has a sand bottom, changing to silt over sand in the lower section. Occasional patches of gravel are present in a few areas. Most of the main channel is subject to scouring and deposition during periods of rapid water flow and by passage of towboats in the shallower stretches. Generally, no rooted aquatic vegetation is present (Olsen and Meyer, 1976).

Main Channel Border -- This is the zone between the 9-foot channel and the main river bank, islands, or submerged definitions of the old main river channel. There are approximately 65,800 acres of this habitat type in the study area. Buoys often mark the channel edge of this zone. Where the main channel is defined only by the bank, a narrow border still occurs, and often the banks have riprap.

The bottom is mostly sand along the main channel border in the upper sections of a pool and silt in the lower. Little or no rooted aquatic vegetation is present. The rock substrate found in wing dams, closing dams, and shoreline protection devices associated with the main channel border frequently provides much needed habitat for fish and invertebrates.

Tailwaters -- These include the main channel and main channel border in the area immediately below the dams which are affected by turbulence of the passage of water through the gates of the dams and out of the locks. Since these areas change in size according to the water stage, no geographic lower boundary has been set below the dams, and therefore, no acreage is given. The bottom is mostly sand and gravel. No rooted aquatic vegetation is present. This habitat closely approximates that habitat which existed prior to impoundment. It is similar to natural river rapids except for the presence of deep scour holes below dams. Available food sources and fast, highly oxygenated water are among the factors that make tailwaters valuable fishery habitat.

Levee Bound Backwaters -- In addition to the habitat types defined by the UMRCC, there are portions of the river which have been landlocked by flood control projects. Acreage of this habitat type is combined with lakes and ponds. These areas are mostly shallow marsh type habitats. The bottom type is primarily silt. Submergent and emergent vegetation abound in this habitat. Due to the shallowness of these areas, they are subject to frequent winter kills making the success of the fishery unpredictable.

III. A. 2. Mussels

Four families of bivalves (clams and freshwater mussels) are present in the Upper Mississippi River drainage and are vital resources to fish, wildlife, and man. These include fingernail clams (family Sphaeriidae), the Asiatic clam (family Corbiculidae), and freshwater mussel families Margaritiferidae (with the spectacle case as the sole representative) and Unionidae (49 species).

Fingernail clams are found in a variety of habitats but are usually most numerous in silty backwater areas. Standing crop estimates of fingernail clams in Pool 19 was estimated at 18,000 clams/m^2 or 1,131 lbs/acre (Thompsom, 1973). These bivalves provide an important source of food for fish such as pumpkinseed, bluegill, channel catfish, bullhead, carp, gizzard shad, smallmouth buffalo, river carpsucker, white sucker and northern redhorse (Jade, 1968; Ranthum, 1969). Fingernail clams are especially important in the diet of diving ducks (Thompson, 1973).

The Asiatic clam, an introduced species, has been reported associated with a power plant near Hudson, Minnesota (Fuller, 1978). Perry (1979) reported it from many sites from Pool 26 below and Brice and Lewis (personal communication) reported taking it from Pools 13 through 19. Its range is gradually increasing and is probably present, although undetected in every pool within the GREAT II reach of the Mississippi River. It has been speculated that the Asiatic clam competes for space with freshwater mussels. While it is probable the Asiatic clam serves as food for fish and ducks, preliminary work (Thompson and Sparks, 1978) indicates the nutritional value to waterfowl is less than native food organisms. Where the Asiatic clam is common, muskrats appear to select it over freshwater mussels (Dennis, personal communication).

Freshwater mussels are of value to fish and wildlife as food. Mussels are a source of food to the freshwater drum, yellow perch and channel catfish (Ranthum, 1969). Ducks may also utilize juvenile mussels. Mussels also serve as substrates for attachment of benthic organisms such as bryozoans, leeches, and aquatic insects. Many of these aquatic organisms are also food for fish. Muskrats, raccoon, and other animals often take both juvenile and adult mussels. Although mussels are taken by these animals throughout the year, most are taken during low water stages.

Approximately, 49 species of freshwater mussels (Appendix 1) exist or have existed within the Upper Mississippi River drainage. Of these species, approximately 37 species are found in the Upper Mississippi River now. There has been a shift in species composition of the mussel beds of the Mississippi River. Some formerly rare species have become common and some common species are now rare. Perhaps 4 species (of these 49 species) have been extirpated from this part of their range. As far as known, no verified specimens of elephant ear, narrow papershell, snuffbox, or fat pocketbook have been taken alive recently by any investigator within the GREAT II reach of the Mississippi River.

The fat pocketbook pearly mussel (a federally endangered mussel) has apparently never been common in most of the GREAT II reach of the Mississippi River. Pratt (1876), Marsh (1887), and Witter (1883) considered this a rare mussel. Van der Schalie and Van der Schalie (1950) reported that this species, although found throughout the Upper Mississippi River, was most common near Hannibal, Missouri. Further search in Pool 22 may yet reveal an extant population of the fat pocketbook.

Another Federally endangered mussel, Higgin's Eye Pearly Mussel, has been found at several sites within the GREAT II reach in Pools 11, 12, 14, 15, 16, 17, 18, and 20 (Kindschi, 1980). It probably exists in other pools. It appears that it may be found wherever mussel beds with high species diversity exist. The status of this species cannot be determined until data on recruitment of juveniles is available.

Several species are rare in the GREAT II reach and only local populations are known. These species are: buckhorn (Pools 16 and 17), ebony shell (Pools 17, 18, and 20), Ohio pigtoe (Pools 16 and 17), yellow sand shell (Pools 17 and 19), and spectacle case (Pools 15, 16, 17 and 19).

Comparison of the mussel populations of the past with existing populations is difficult because of the lack of data for comparison both past and present. As far as known, no standing crop estimates were or have been made for any of the pools of the Mississippi River. It appears that mussel populations are reduced from their former abundance. However, the mussel population of the Upper Mississippi River may well be less damaged than any other large rivers in North America (Stansbery, 1966).

The ecology of mussels is comple and several factors probably have impacted mussel populations. Of the several factors controlling mussel populations, the main factors are: availability of fish host, suitable bottom substrate, suitable water quality, and overharvesting.

If there is a shift in the relative abundance of fish hosts, over time there will be a shift in the mussel populations. This is due to the fact that mussels have a life stage (glochidia) that is parasitic on the gills of fish. Several species of mussels are host specific (Fuller, 1978). An example of this change in mussel species from the loss of a fish host is the decline in ebony shell populations since the construction of the Keokuk Dam and the 9-foot navigation channel. This construction hampered the upstream movement of skipjack herring which is the host fish for the ebony shell. Smith (1976) reports only the sporadic taking of this fish in the GREAT II reach. The ebony shell was once one of the dominant mussels with some beds containing 85 percent ebony shell (Coker, 1919). However, it is now rarely taken.

Bottom substrate changed with the construction of the Keokuk Dam and formation of the Keokuk pool (Pool 19) for hydro-electric use in 1913. Many of the formerly productive beds were covered with silt because of changing current patterns (Ellis, 1931). Although no similar data is known to exist for the other navigation pools, it is assumed that mussel beds were similarly covered by silt and sand in the newly formed pools.

The water quality of the area has changed since settlement. Sources of water pollution include both point sources and non-point sources. Since mussels are filter feeders, they accumulate many of the substances they filter.

Harvesting of mussels for the button industry is long past. The abuses of mussel overharvesting for the button industry are well documented (Coker, 1919). The present harvesting of mussels for the cultured pearl industry is somewhat different. In contrast to the pearl button industry, the cultured pearl industry does not take small shells (usually not less that 3 3/4 inches in diameter), takes only one or two species, and predominantly uses diving and mussel dredges rather than brailing (crowfoot bar). It is uncertain at what level mussel resources may be harvested without depleting mussel stocks. Overharvesting would eventually lead to an increased number of shells below the size needed by the cultured pearl industry. This industrial size limit may limit the harvest.

III. A. 3. Fish

In the past, the natural processes of the river were a continuous cycle of creation and destruction of the first five aquatic habitats noted above. Simons et al explain that "river channels are continually undergoing changes of position, shape, dimensions, and pattern". As the river eroded away a bank and cut a new channel, flow was diverted from the older channel(s) and the decreased flow resulted in greater sedimentation in the old channel(s) eventually blocking through flow altogether and creating a river lake or slough (Figure 8). The relative proportion of habitats has changed over the decades due to natural action as well as man's activities, and abundance of fish species associated closely with certain habitats has changed in response. Presently there are 102 species known to occur or have occurred on the GREAT II stretch of the Mississippi, pools 11-22 (Appendix 2). Of these, 36 species are generally considered common or abundant, 36 species uncommon or occassional, 23 species as strays or rare, and 7 species have not been taken within the past decade. Certain species may be common on one portion of the river but uncommon or rare in others.

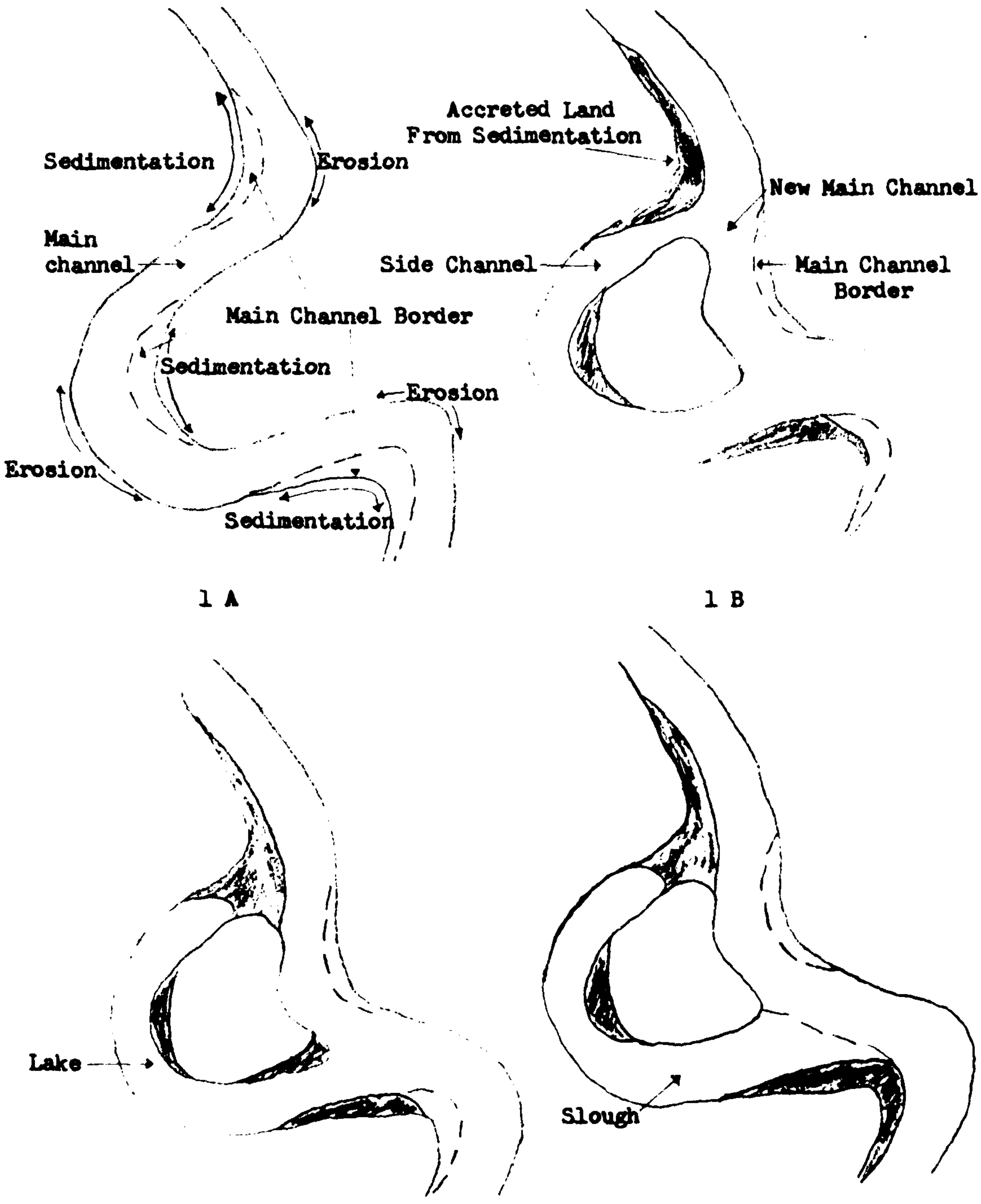


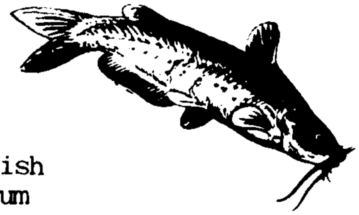
Figure 8. Cycle of habitat creation and destruction in the Mississippi prior to navigation channel projects.

Considering the seven species taken historically but not recently, it is apparent that five were probably strays as they are either not typically found on large rivers or were out of their normal range - common shiner, mimic shiner, creek chub, pirate perch and fantail darter. Discounting all strays, there are 81 species that historically or presently characterize the Mississippi in the GREAT II reach. Out of these 81 species, two no longer occur, and seven are considered rare. Impacts from construction and maintenance of the nine-foot navigation channel may have been detrimental to three of the nine absent or rare species. The blue catfish was collected historically as far north as Lynxville, Wisconsin, (Pool 9) but was not common above Keokuk (Pool 19) according to Coker (1919) who stated that dams blocked movement of this migratory fish. Since the blue catfish still occurs in the unpooled river downstream of the GREAT II stretch, it is obvious that the navigation dams are partly or wholly responsible for its disappearance from the pooled section of the river. Pflieger (1975) states the lake sturgeon was once abundant, but was overfished before 1900, drastically reducing populations that were further hurt by construction of the dams which blocked spawning migrations and increased siltation. The rock bass prefers gravel river bottoms and the reduction of gravelly areas due to the dams' slowing of river current and increasing siltation, is suspect in their decline. In 1967, the UMRCC described the rock bass as "uncommon", but by 1979 its status has slipped to "rare" (Appendix 2). The remaining six species were probably always rare due to habitat preferences or range distribution, and five may have stable populations.

Impacts from the construction and maintenance of the nine-foot channel are not as evident in those species more abundant, although modifications of river habitats must affect them. The 72 uncommon to abundant species include those that support the sport and commercial fisheries or the river. Most are usually associated with particular types of habitat although they may use other habitats during certain stages of life or seasons of the year. Carp and gizzard shad are two abundant species found commonly in all habitats. Following is a habitat preference breakdown for the economically important and/or better known species of the river.

Main Channel

shovelnose sturgeon	channel catfish
American eel	flathead catfish
shorthead redhorse	freshwater drum



Main Channel Border

smallmouth buffalo
shorthead redhorse
channel catfish
flathead catfish
freshwater drum

Side Channel

river carpsucker
smallmouth buffalo
bigmouth buffalo
shorthead redhorse
channel catfish
smallmouth bass
white bass
sauger
freshwater drum

Sloughs

bowfin
bullhead species
green sunfish
warmouth
crappie species
freshwater drum
flathead catfish
white bass
smallmouth bass
sauger
walleye

Tailwater

paddlefish
white bass
sauger
walleye
freshwater drum

River Lakes and Ponds

paddlefish
gar species
northern pike
river carpsucker
bigmouth buffalo
bluegill
rock bass
warmouth
largemouth bass
crappie species

III. B. UTILIZATION OF FISH RESOURCES

III. B. 1. Sport Fishery

The sport fishery of the Upper Mississippi River (UMR) is usually diverse, owing to the diversity of habitat and associated fish

communities found in this pooled river situation. The sport fishery utilizes a combination of warmwater and coolwater species associated with habitats varying from lake to fast flowing river.

Several comprehensive creel surveys measuring sport fishing utilization have been conducted on the UMR by personnel from bordering states (Cleary, 1957; Nord, 1964; Wright, 1970; Fleener, 1975, Fleener, 1976). The following discussion summarizes findings from those surveys on characteristics of sport fishing in the GREAT II portion of the UMR (Pools 11-22), covering some 314 miles of river. The GREAT II Recreation Work Group report entitled, "Recreation Use Projections and Needs Report," provided activity days noted in the discussion. For specific pool discussions, see Section V of this report.

Approximately 30 species comprise the sport fishery in the GREAT II portion of the UMR. Table 5 lists the species which have been recorded in one or more of the creel censuses performed on Pools 11 through 22. This listing reflects the diversity of the fish community present. Only two species, "trout" and "lake sturgeon", have been recorded in creel surveys in the GREAT I portion and have not been specifically documented in creel surveys in the GREAT II portion.

With a few exceptions, only one-third of the species recorded are actively sought by sport fishermen (excluding anglers fishing for "anything that bites"). Bluegill, black and white crappies, sauger, walleye, channel catfish, white bass, largemouth bass, paddlefish, bullhead, freshwater drum, and carp are the major species sought in the GREAT II portion. Angler preference varies dramatically by pool, and within different habitats of any given pool. Some changes in angler preference have taken place over the last 10 to 20 years as well. The proportion of anglers seeking bluegill and crappie has decreased from 32 percent in 1962-63 to 20 percent in 1972-73. The proportion of anglers seeking walleye and sauger, on the other hand, has increased over the same period from 16 to 32 percent. While no anglers were recorded as actively seeking paddlefish in earlier creel surveys, recent legalization of snagging, in all states except Wisconsin, has resulted in an angler preference for that species in many tailwater areas (13 percent in 1976 below Lock and Dam 16) (Waters, 1977).

In general, anglers in the GREAT II portion are not very specific in their preference of fish. According to the 1962-63 creel census, over half of the total anglers contacted were seeking "any species". The habitats most often fished in the GREAT II portion of the river are tailwaters, navigation and non-navigation channels.

TABLE 5

Species Recorded in Various Creel Surveys Conducted in Pools 11 to 22 of the Upper Mississippi River

shovelnose sturgeon	yellow bass
paddlefish	rock bass
gar	warmouth
bowfin	green sunfish
American eel	orangespotted sunfish
gizzard shad	bluegill
mooneye	smallmouth bass
northern pike	largemouth bass
carp	white crappie
suckers	black crappie
buffalofish	other sunfishes
blue catfish	yellow perch
channel catfish	sauger
flathead catfish	walleye
bullheads	freshwater drum
white bass	

On the UMR as a whole, bluegill and crappie are the species most utilized by sport fishermen. Table 6 lists the ranking of the major species harvested from Pools 4, 5, 7, 11, 13, 18, and 26 during the three comprehensive creel surveys as an overall perspective. This order of ranking changes dramatically from the upper to the lower pools, however. The 1956-57 survey recorded the species ranking for each pool and provides a measure of the species ranking in the GREAT II portion of the river. Based on their mean rank in the harvest from pools 11-22, the species ranking in decreasing order were freshwater drum, channel catfish, crappies, bluegill, white bass, sauger, carp, and walleye. Species ranking in the GREAT I portion was considerably different. Bluegill, which ranked first in only one of the GREAT II pools, ranked first in two-thirds of the upper pools and first overall, followed by sauger, crappies, white bass, freshwater drum, walleye, channel catfish, and carp. This difference in the importance of bluegill in the creel is attributable in part to the difference in habitats most fished and the lack of a significant ice fishery in the lower pools.

The quality of the sportfishing in the UMR is good to excellent. An average catch rate of 1.0 fish per hour angling is generally considered excellent. Seasonal average catch rates for Pools 11, 13, and 18 during the 1962-63, 1967-68, and 1972-73 surveys ranged from 0.6 to 1.5 (Table 7). The lowest average annual catch rate found in the various surveys that have been conducted was 0.54 fish per hour during Fleener's recreational use survey of Pool 21 in 1973-74.

It must be remembered that these are average annual values for an entire pool. Much higher catch rates occur in certain portions of a pool and at certain seasons. For example, during a four month 1976 creel census in the tailwaters of Lock and Dam 16, monthly catch rates were as high as 4.1 for June shore anglers and averaged 2.1 for the entire census.

Comparing data from the various surveys conducted, there is some evidence of a decreasing trend in catch rate in the lower pools. During the three surveys conducted on Pools 11, 13, and 18, the catch rate was greatest on Pool 11 in all surveys, and the lowest in Pool 18 during two of the three surveys. The 1973-74 catch rate further downstream in Pool 21 was lower than any of the above (Table 7).

Fishing pressure on the UMR is relatively light compared to other bodies of water. From various surveys conducted on an entire pool, the pressure ranged from less than 2 hours per acre (Pool 18, 1972-73) to just less than 20 hours per acre (Pool 21, 1973-74) (Table 7). By comparison, smaller impoundments may commonly

TABLE 6

Top Ten Ranking of Sport Fish by Total Number of Fish
Harvested in Upper Mississippi River During Three Creel Surveys

Species	Period 62-63			Period 67-68			Period 72-73		
	#Caught	-	%of Catch	#Caught	-	%of Catch	#Caught	-	%of Catch
Bluegill	537,587	-	37.0	414,280	-	28.7	350,510	-	26.1
Crappie	397,322	-	27.4	366,469	-	25.4	219,445	-	16.4
White bass	123,556	-	8.5	100,524	-	6.9	140,617	-	10.5
Freshwater drum	94,224	-	6.5	153,806	-	10.7	159,849	-	12.9
Sauger	85,002	-	5.9	116,480	-	8.1	213,242	-	15.9
Channel catfish	76,554	-	5.2	116,008	-	8.0	77,461	-	5.8
Yellow perch	52,190	-	3.6	29,995	-	2.2	35,104	-	2.6
Walleye	34,116	-	2.4	77,347	-	5.4	92,811	-	6.9
Bullhead	25,742	-	1.8	29,112	-	2.0	14,720	-	-
Largemouth bass	24,961	-	1.7	37,804	-	2.6	19,970	-	1.6
Green sunfish	160	-	-	4,404	-	-	16,978	-	1.3

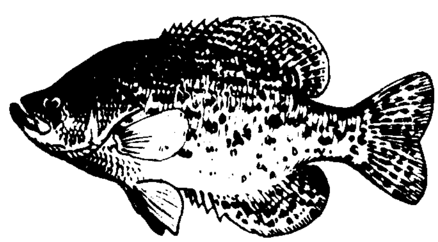


TABLE 7

A Summary of 1962-63, 1967-68, and 1972-73 Creel Data For Pools 11, 13, and 18; and 1973-74 Creel Data for Pool 12.

Pool	Period	Pressure	Catch Per Hour	Number Harvested	Weight Harvested	Hours Per Acre	Number Harvested Per Acre	Pounds Harvested Per Acre
11	1962-63	168,523	1.115	191,259	119,327	8.48	9.62	6.00
13	1962-63	187,100	.600	123,646	46,221	6.65	4.40	1.64
18	1962-63	123,991	.840	105,024	90,867	10.56	8.94	-
11	1967-68	265,987	1.092	290,458	142,927	13.38	14.60	7.19
13	1967-68	216,434	1.054	228,121	118,932	7.70	8.10	4.23
18	1967-68	147,984	.949	140,437	83,669	12.60	11.96	7.12
11	1972-73	223,350	1.477	329,446	247,613	11.22	16.58	12.46
13	1972-73	179,016	.896	160,399	93,980	6.37	5.70	3.34
18	1972-73	20,514	.724	14,852	8,867	1.75	1.26	0.75
21	1973-74	125,040	.540	68,140	-	19.70	9.26	-

receive over 200 hours per acre of fishing pressure. It should be noted though that the pressure is not distributed evenly over an entire pool, and certain areas such as tailwaters undoubtedly do receive over 200 hours per acre pressure. Total fishing pressure for the GREAT II portion of the UMR is approximately 4,899,000 activity days or 35 percent of the total recreational activity in the study area (GREAT II Recreational Work Group, 1979). Based on nationwide surveys of the U.S. Fish and Wildlife Service, anglers in the study area expend approximately $46.5 million annually (1975 dollars) including license fees.

Estimated sport angler harvest per pool ranged from a low of 14,852 fish from Pool 18 in 1972-73 to 329,446 fish from Pool 11 during that same period (Table 7). Related to an area basis, this amounted to only 1.26 to 16.58 fish harvested per acre. This is a relatively low harvest compared to smaller inland lakes which yield harvests of well over ten fold that amount. It is likewise low compared to harvest from pools in the GREAT I portion of the river. All pools surveyed in the GREAT I portion had sport harvests of over ten pounds per acre in all three surveys, while in the GREAT II portion only Pool 11 in 1972-73 had a harvest of over ten pounds per acre. The sport harvest for the GREAT II reach (Table 8) was calculated by proportioning the total and mean harvest per acre of Pools 11, 13, and 18 to the other pools. These ranged from 1,117,000 to 1,753,000 fish and 682,000 to 932,000 pounds.

TABLE 8

Grand Total Estimates for Pools 11-22 of the Upper Mississippi River During Three Creel Survey Periods

Period	Hours Pressure	Fish Harvested	Pounds Harvested
1962-63	1,275,773	1,117,011	682,064
1967-68	1,676,877	1,752,982	919,104
1972-73	1,124,063	1,342,494	932,224

In summary, Pools 11 to 22 of the Upper Mississippi River support a diverse, quality sport fishery. Characteristics of that fishery vary considerably by pool, habitat, season and year. Major species harvested are freshwater drum, channel catfish, crappies, bluegill and white bass.

Mussels - In recent years, Upper Mississippi River commercial mussel fishing has rejuvenated. The mussels taken for use in the cultured pearl industry are primarily washboard and three-ridge. Other species that are also occasionally sold (if large enough for use) are maple-leaf, pimple-back, and monkey face. However, shell buyers in 1979 were buying only washboard. The price for these shells has varied in 1979 from $180 to $240 per ton. Recently, a new market for pink nacred shells, such as the pink heelsplitter and the black sandshell, has developed for use in jewelry. The price for these shells has been up to $500 per ton.

Judging by the present commercial operations, which could not exist without substantial populations, Pools 14, 15, 16, 17, and 19 may be the best remaining pools within the GREAT II reach of the Upper Mississippi River. However, the location of shell buyers also influences where mussels are harvested.

The commercial harvest in the study area is estimated to be 469,000[1/] pounds at an estimated first market value of $29,000.

Fish - Commercial fishing on the Upper Mississippi River (UMR) is a major consumptive use of the resource (Figure 9). Approximately 2,500 commercial fishermen are licensed on the entire UMR each year. During the period of 1953-1977, the reported commercial catch for the GREAT II area was 112,830,000 pounds with an average annual harvest of 4,500,000 pounds. Reported first market value of this catch was $9,900,000, with a yearly average of $397,000. Commercial fishing provides a much needed source of protein, an opportunity for self employment to the fishermen, and an important management tool for the fish biologist.

The following text is condensed from the 1979 UMRCC Fisheries Compendium (Rasmussen, 1979. "Analysis of the Upper Mississippi River Commercial Fishery" by Kline and Golden). The data includes catch statistics from 1953 through 1977.

The commercial fishery is composed of four major species groups (carp, buffalo, catfish and freshwater drum) and thirteen minor species groups (paddlefish, sucker-redhorse, bullhead, carpsucker, shovelnose sturgeon, gar, bowfin, eel, crappie, northern pike, mooneye, goldeye, and white amur). Paddlefish are not fished commercially in Wisconsin. Northern pike is no longer commercially fished in any of the states in the study area.

The four major species which dominate the UMR commercial fishery contributed 95 percent of the catch and 99 percent of the monetary or commercial value for the 25-year period (1953-1977). Data for these four species is treated separately in the following paragraphs.

1/ Data is only available from Iowa.

Carp completely dominate the UMR commercial harvest. Although considered an undesirable fish by many people, its reputation as a food fish is growing and the harvest of carp has increased significantly over the 25-year period. Carp is considered the principal under-utilized species in the river because the available stock is much greater than the market demand.

Carp are taken throughout the GREAT II reach; but the principal harvest areas are found in Pools 13, 18 and 19. Harvest in Pool 15 has been the lowest. Carp harvest in Pools 10, 13, 15, 17, and 25 show an increase through the period of analysis. Harvest in Pools 18 and 19 underwent a decline between 1958 and 1972 then increased during the last 5 years to equal the first five years of record. The average market price to the fisherman has ranged between 5¢ and 8¢ per pound. Prices has high as 50¢ per pound have been reported. Consumer market prices are usually much higher when sold locally.

Figure 9. Commercial fishing.

Buffalo have achieved a much better reputation as food fish than carp; and, therefore, are much higher in the market demand preference scale, as judged by price. Buffalo are taken throughout the GREAT II reach, but the principal harvest areas are found in Pools 13, 18, and 19. Harvest in Pools 21 and 22 have been lowest. Buffalo harvest in Pool 17 is increasing.

The average price per pound has ranged from 13¢ to 19¢. Buffalo prices as high as 35¢ have been reported.

Catfish are the most sought after commercial fish species in the River because of their high market value, and appear to have been overexploited in many pools during the last 25 years. The harvest of catfish appears to have decreased slightly over the 25-year period.

Although catfish harvest has been well distributed throughout the GREAT II region, harvest has been greatest in Pools 18 and 19. Harvest in Pools 15 and 22 has been insignificant. Catfish harvest in Pool 13 is on the increase while harvest in Pools 20 and 24 is decreasing.

The demand for catfish has remained high and the average price per pound at the fish market has ranged between 25¢ and 45¢. Prices as high as 65¢ per pound have been reported.

Freshwater drum are very important to the River's fishery. They rank fourth in both the sport and commercial harvest. The commercial harvest of freshwater drum has increased significantly over the 25-year period. Freshwater drum harvest has been evenly distributed over the period of analysis. In the GREAT II reach, harvest is greatest in Pools 18 and 19. Harvest in Pools 15 and 22 have been insignificant. Freshwater drum in Pools 11 and 16 have shown an increase while harvest in Pool 16 is decreasing.

The average price per pound for freshwater drum declined from 11¢ per pound to 8.5¢ per pound between 1953 and 1972. However, by 1977 the average price had risen to 10¢ per pound.

Thirteen species groups are considered to be of relatively minor importance to the commercial fishery harvest (5 percent) and value (1 percent). However, they do attest to the species diversity; and in many cases, allow for the use of otherwise unutilized fish stocks for human benefit. Species groups considered to be of minor importance are ranked below by their weight harvested: Paddlefish, suckers, and redhorse, bullhead, carpsucker, gar, bowfin, mooneye and goldeye, northern pike, crappie, American eel and white amur.

The reported commercial fishery harvest has shown a significant increasing trend from 1953 through 1977. Closer examination of the data shows a general increase until the early 1960's; then harvest decreased and peaked again in 1970. This has been followed by an overall decline to the present.

Distribution of harvest in the GREAT II study area provides insight into important fishing areas. Pool 19 (22,524,500 pounds), Pool 18 (18,397,760 pounds) and Pool 13 (16,886,865 pounds) stand out as the most productive. These three pools yielded a total of 57,809,125 pounds of fish during the 25-year period. This accounts for 47 percent of the GREAT II yield.

In summary, since 1943 management of most UMR commercial fish species has been carried on through the auspices of the UMRCC. Liberalization of regulations has been the general rule, based on biological information collected and discussed by the member states.

III. C. WILDLIFE RESOURCES

III. C. 1. Wildlife Habitat

Terrestrial habitat within the reaches of the GREAT II study area can be placed into 7 major cover type categories. They are aquatic marshlands, herbaceous growth, forestlands, agricultural lands, sand and mud, dredged material and developed lands. Open water areas support significant numbers of wildlife species including waterfowl, gulls, eagles, vultures, and insect eating birds. But for the purpose of describing cover types, open water will be considered for its associated value to wildlife and not be given a qualitative evaluation in this report. The acreages quoted below have been summarized from the "Upper Mississippi River Habitat Inventory" (Hagen, Werth and Meyer, 1977). These figures should be considered on the low side because the entire UMR floodplain was not inventoried.

Aquatic Marshlands can be considered those zones of transition from open water to terrestrial habitat. Approximately 8,840 acres of this habitat type are found in the study area. Frequently flooded areas of this type support prolific populations of wildlife because of their cover diversity, available food, loafing and escape cover and breeding habitat. Species relying on this cover type include, ducks, coot, rails, bitterns, herons, egrets, numerous song bird species, associated resident hawks, wintering eagles and osprey. Many species of insects, amphibians, reptiles, and furbearers including muskrat, mink, fox, raccoon, opossum, beaver and otter are found in marshlands. In fact, the aquatic

marshlands of the Mississippi River produce and sustain higher numbers of wildlife than any other land category.

Herbaceous Growth lands support mixed stands of grasses including Reed's canary grass, rice cutgrass, other mixed forbs and broadleaf weeds. Approximately 7,660 acres of this habitat type are found in the study area. Except for overlap occurring near marsh edges and occasional openings in timber that provide good habitat interspersion, these grassy areas are generally not as productive for wildlife compared to forest lands or marshland. They offer moderate loafing cover for deer and nesting cover for passerine bird species.

Forestlands comprise the lion's share of the Mississippi River's remaining undeveloped land. Approximately 75,000 acres of this habitat type are found in the study area. These floodplain forest communities range from the Cypress bottomlands in Missouri to the elm-ash-cottonwood-river birch-silver maple forests found in the middle and upper reaches of the river. Elm has diminished in status from a once common occurance of 20 percent to less than 1 percent of the floodplain forest composition today. Other than that, much of the spectrum of tree species has remained the same. Mast producing trees common to this portion of the Mississippi River include shagbark hickory, bur oak, pin oak, red oak, swamp white oak, white oak, and black walnut. Three of these species, swamp white oak, red oak, and pin oak offer the greatest number of mast producing trees in the central reaches of this segment of the river. In general, mast producing trees produce the greatest amount of food for floodplain dwelling wildlife species. Most all tree species offer themselves to cavity nesting wildlife species at some point in their growth span. Standing dead trees contribute sources of food and homes for wildlife as well.

Agricultural Lands includes open areas which are devoted to annual crops, pastures, fallow ground, and fields that show some sign of recent cultivation. Approximately 31,300 acres of this habitat type are found in the study area. These cultivated areas are located on the driest parts of the floodplain. This habitat type is an important food source for mammals. Many of the small rodent-type species make extensive use of this habitat throughout all phases of their life cycle. Species expected to utilize this habitat, include the opossum, raccoon, white-tailed deer, striped skunk, woodchuck, coyote, short-tailed shrew, deer mouse, white-footed mouse, prairie vole and house mouse. This cover type is more important as a foraging habitat for birds than a nesting area, although there is some nesting at the edges of fields. Flooding of cultivated fields attracts migratory shore and wading birds and ducks and geese. These areas provide foraging habitat for reptiles. Amphibian use is largely restricted to drainage channels, edges adjacent to waterways or periods of flooding.

Sand and Mud areas can best be described as being deposited by floodwaters. Approximately 1,400 acres of this habitat type are found in the study area. They are generally short lived in nature, soon to become vegetated with herbaceous or woody growth. They act as production zones for aquatic invertebrates, feeding and loafing areas for waterbirds, loafing areas for waterfowl and foraging areas for mammals.

Dredge Material areas are predominantly sandy. Approximately 780 acres of this habitat are found in the study area. Habitat provided/destroyed by spoil deposition is related to how and where the material is placed. For example, material placed underwater provides very little habitat, destroys existing aquatic habitat and reduces water area. Material deposited, in the water, in a configuration similar to sand flats will undergo similar successional patterns and provide similar habitat. However, placement destroys existing aquatic habitat and reduces water area. Material deposited on existing islands immediately destroys all existing habitat; however, succession frequently follows.

Developed Lands include areas dominated by industrial or commercial types of structures and those environs which are greatly influenced by industrial development and urbanized areas. Approximately 9,700 acres of this habitat type occurs in the study area. Common industries are grain elevator operations, power companies, fertilizer plants, barge docking and loading areas. Very few species depend on developed land for the completion of any life stage. Use is normally transitory providing resting perch for birds or travel routes for mammals. Several species may be attracted by insects found at night in lighted areas or by warm water effluents.

III. C. 2. Avian Species

The Upper Mississippi River provides habitat diversity for approximately 300 species or birds. At least 100 species use the river corridor for nesting. The river, part of the Mississippi Flyway, serves as a major north-south migration route for avian wildlife. Species common to east and west ornithological ranges are present. Appendix 3 identifies birds found on the Upper Mississippi River.

Passerine Birds - The deciduous forest of the river corridor is used by the group of birds commonly referred to as song birds. This group of birds includes nearly one-half of the total species using the Mississippi Flyway. Representatives of this group includes such birds as warblers, sparrows, swallows, thrushes, and all other migratory non-game species. The forest habitat in the Mississippi River corridor is used by approximately 150 species of passerine birds for either migration or nesting.

Raptors - Birds of prey or raptors use the river area during specific periods throughout the year. Many species nest in the river corridor while others are abundant during spring or fall migration (Appendix 3). Large numbers of broad-winged hawks have been observed at the Louisa Division of the Mark Twain National Wildlife Refuge during fall migration periods. Concentrations of the endangered bald eagle occur during the late fall, winter and early spring along the Mississippi River corridor. The open water areas below each of the lock and dams or warm water discharges of power generating plants provides feeding sites for the eagles, during the winter months. Concentrations of bald eagles may exceed 400 adult and immature birds. The river corridor also provides habitat and a migration route for the endangered peregrine falcon.

Fish Eating Colonial Water Birds - This group is represented by herons, egrets, cormorants, and terns. Herons and egrets nest in traditional rookeries usually located below lock and dams in the upper one-third of the pool. These birds nest in shallow backwaters with the nests being located in live or dead trees such as elm, cottonwood, maple, oak, and ash. The only nesting colony of double crested cormorants in the GREAT II study area occurs in Pool 13.

Shorebirds - A minimum of 30 species of shorebirds use the available habitat in the river corridor for nesting and migration. Exposed sandbars and mud flats provide feeding habitat for shorebirds. Only a small percentage of the 30+ spcies have been recorded as nesting in the river corridor.

Waterfowl - Ducks and geese use the habitat of the river corridor extensively throughout the year. Large concentrations are evident during fall and spring migration periods. The Mississippi River corridor provides crucial migration habitat for 28 species of waterfowl migrating from as far away as Alaska, Hudson Bay, the McKenzie River Delta, and Baffin Island. Peak numbers of waterfowl can range from 160,000 to 350,000 on the Upper Mississippi River Wild Life and Fish Refuge. The Mark Twain NWR peaked at 580,000 ducks and 45,000 geese during the fall of 1978. Approximately 15 percent of the total continental canvasback population and 12 percent of the total redhead population use the river corridor during the fall migration. During the spring migration, this population increases to nearly 36 percent for both populations (Bellrose, 1976). Some geese and ducks overwinter along the river in open water areas usually associated with generating plants, lock and dams, and in a few instances grain elevators. Mallards, goldeneye, and Canada geese are representative of the species which usually overwinter.

Approximately 2,500,000 dabbling ducks utilized the Mississippi Flyway each fall. The majority of these being mallards. Other

dabblers included the wood duck, pintail, black duck, gadwall, American wigeon, blue-wing teal, green-winged teal, and northern shoveler. Within each Flyway, migration corridors have been distinguished. The study area lies within the Mississippi River Corridor, which has the greatest density of dabblers of any corridor east of the Rocky Mountains (Bellrose 1968). Dabbling ducks generally feed in shallow waters, although some utilize grainfields while migrating and/or wintering.

Common diving ducks of the Mississippi Flyway include the lesser scaup, ring-necked duck, canvasback, redhead, common goldeneye, and bufflehead. The most common diver in the Mississippi River Corridor is the lesser scaup (Bellrose, 1968). While divers feed largely upon aquatic plants and animals (Trippersee, 1953), they may visit flooded cornfields (Madson, 1964).

Common geese in the study area include Canada Geese, lesser snow/ blue geese, and white-fronted geese.

Habitat in the river corridor is ideal for the tree cavity nesting wood duck. Shallow backwaters provide brood habitat needed for rearing young wood ducks. Thousands of wood ducks are reared in the GREAT II area each year.

Upland Game Species and Other Migratory Species - The river corridor has limited habitat suitable to most upland game bird species such as ruffed grouse, bobwhite quail, wild turkeys, and ring-necked pheasants. Habitat in the river area is, in many places, ideally suited to such game species as common snipe, woodcock, sora, king and virginia rails, and to a lesser degree, mourning doves. Good to fair populations of ruffed grouse and wild turkey occur along the wooded river bluffs of the Upper Mississippi River Wild Life and Fish Refuge.

III. C. 3. Mammals

Wildlife habitat along the Upper Mississippi River supports an abundant and diverse mammal population. Fifty-two mammal species (Appendix 4) with ranges overlapping the GREAT II study reach have been identified.

The lock and dam system greatly increased aquatic habitat in most areas of the UMR with a subsequent rise in aquatic-oriented mammals. Muskrat, beaver and raccoon are commonly found in the backwaters of the study area. River otter, mink and nutria can also be observed, however, they are much rarer. Small mammal species typically associated with moist soil communities include the masked shrew, meadow vole, and southern bog lemming.

Small terrestrial mammals common to the study area include the eastern mole, least shrew, short-tailed shrew, western harvest mouse, white-footed mouse, deer mouse, meadow vole, and prairie vole. Ten species of bat are known to occur in the study area. These animals forage throughout the floodplain returning to hollow trees and crevices in tree bark to roost.

The gray and fox squirrels are quite common in woodlands of the study area. The southern flying squirrel is also abundant in the densely forested areas.

Large mammals include the coyote, red and gray foxes. The red fox and coyote are extremely versatile and have been able to increase in numbers as man has altered the environment. The gray fox is at home in the forest, river bottoms, and bluffs.

White-tailed deer are common in the study area, although much of their habitat is not considered prime because of the advanced successional stage of the woodlands reducing foraging areas.

III. C. 4. Amphibians and Reptiles

The diverse habitats found within the GREAT II study area provide suitable habitat for a wide variety of amphibians and reptiles. However, because of their relatively insignificant economic importance and cryptic nature, they have not been as well studied as other species. A total of 20 amphibians and 41 reptiles have ranges which include all or part of the study area (Appendix 5).

Smith (1961) has delineated the area bordering the Upper Mississippi River in Illinois as a distinct herpetofaunal region due to its high number of amphibians and reptiles. This species richness is due to several factors: occurrence of extensive rock habitat, occurrence of sand areas, and the continuity of wooded and shallow aquatic habitats along the river. This corridor has allowed the extension of several species into a region that was formerly prairie and is now dominated by agricultural land.

<u>Salamanders</u> - The mudpuppy, smallmouth, dark-sided, and eastern tiger salamanders are all common in parts of the study area. The four-toed and spotted salamanders and the central newt are considered rare. Since all these species have aquatic larval stages (the mudpuppy is permanently aquatic), the small pools in the bottomlands probably provide the best habitat. However, the presence of fish in ponds normally makes them undesirable for breeding sites. The mudpuppy and larval stages of the other salamanders are highly sensitive to water pollution and sedimentation.

Frogs - Thirteen species of frogs and toads occur in the GREAT II area. The most common species include the bullfrog, northern and southern leopard frogs, western chorus frog, Blanchard's cricket frog, and gray treefrog. The Fowler's toad is generally more common than the American toad in the lowlands. Other species occurring in the area include the spring peeper, crawfish frog, wood frog, pickerel frog, and green frog.

Like the salamanders, frogs are most commonly found in bottomland forests and shallow aquatic areas. As amphibians, frogs and toads require ponded areas in which to breed although the larger species (bullfrog and green frog) usually require permanent water.

Turtles - The common snapping turtle and western painted turtle are likely the two most abundant turtles in the area. Backwater conditions generally favor the occurrence of the map turtle and the spiny softshell over the false map turtle and smooth softshell. The Blanding turtle, red-eared slider, stinkpot, eastern box turtle, and ornate box turtle all are uncommon or occur in varied numbers due to range or habitat restrictions. Both the alligator snapping turtle and Illinois mud turtle are historically very rare in the GREAT II area.

Turtles make use of levees or dredge spoil sites as nesting areas if they are elevated and well-drained. Softshell or snapping turtles may be important predators of fish in specific localities, but generally their influence on fish stocks is not thought to be great. A small scale and variable commercial harvest exists for turtles, but it is insignificant when compared to commercial fishing.

Lizards - The western slender glass lizard, six-lined racerunner, five-lined skink, and broad-headed skink occur in the area. Only the six-lined racerunner is locally common. This species is usually found along bluffs or dry hills.

Snakes - The GREAT II study area lies within the range of 24 species of snakes. Several of these species are uncommon in the river corridor because they primarily occur in prairie areas. Backwater areas are inhabited by a variety of water snakes, the most common of which are the northern and diamond-backed water snakes. Other species, such as the western worm snake, prairie ringneck snake, northern copperhead and timber rattlesnake are found primarily in the bluffs and rock outcrops bordering the river. Blue racer, western ribbon snake, eastern garter snake, and the midland brown snake are common species in wooded or open habitats.

Three venomous species have been recorded from the area. The eastern massasauga occurs in lowland swamps but is generally uncommon. Both the northern copperhead and timber rattlesnake occur on wooded bluffs, but only the timber rattlesnake is found throughout the area.

III. D. UTILIZATION OF WILDLIFE RESOURCES

Utilization of the wildlife resources of the Upper Mississippi River fall into two categories: consumptive and nonconsumptive. Consumptive uses, such as hunting, fishing, and fur trapping, remove a portion of the resource from the environment. Hiking, nature photography, and bird watching are examples of nonconsumptive uses. The value of wildlife on an economic basis related primarily to its value as a recreational, scientific and aesthetic use are difficult to measure.

Harvest data are available on a regional basis from Illinois and Missouri. Information from Iowa is compiled on a country-wide or zone basis. Data was not provided by the state of Wisconsin. However, data from the Cassville District of the Upper Mississippi Wild Life and Fish Refuge has been used to reflect in part harvest trends in Wisconsin. Computations and assumptions used to derive data for the study area are in Appendix 22. All data represent 1977 surveys.

Approximately 640,000 days are spent annually afield in hunting and trapping activities in the GREAT II study area. Based on the nationwide surveys of the U.S. Fish and Wildlife Service, hunters expend over $8.3 million (1975 dollars) annually in the study area including license fees. Trapping provided approximately $1,630,500 worth of pelts in 1977.

III. D. 1. Small Game Mammals

Species of small mammals hunted in Illinois, Iowa and Missouri include: rabbit, fox squirrel, gray squirrel, woodchuck, raccoon, red fox, gray fox, and coyote. More rabbits and squirrels were harvested annually than any other small game species.

<u>Fox and Gray Squirrels</u> - Both species of squirrels are common throughout the study area; in Illinois, fox squirrels are more abundant than gray squirrels (Preno and Labisky, 1971). The gray squirrel is more closely associated with mature forest habitats and is, therefore, most abundant in the wooded bluffs and river floodplains (Brown and Yeager, 1943). Adequate den trees and mast production are essential for both species. More than 160,000 squirrels were harvested within the study area; over 107,000 hunter days were spent in the sport (Appendix 6).

<u>Cottontail Rabbits</u> - The cottontail rabbit is most abundant in semi-forested areas, particularily in brushy or woody fields, in thickets along fencerows and woodlots, forest edges, and dry bottomlands (Hoffmeister and Mohr, 1957). More Illinois

residents hunted rabbits than any other small game species (Preno and Labisky, 1971). The annual harvest in the study area is 186,000 rabbits representing 89,000 hunter trips (Appendix 6).

Woodchuck - The woodchuck is most abundant in the protected floodplain in close association with open agricultural areas and forest edges. Because of flooding frequency, woodchucks are less abundant in the unprotected floodplain. Data on woodchuck harvest is available only from Missouri. An estimated 170 woodchucks were harvested in the Missouri portion of the study area; over 390 hunter use days were expended (Appendix 6).

White-tailed Deer - Deer are common in the study area, where they utilize a variety of habitats including bottomland forests and sloughs, as well as cultivated fields. An estimated 3,000 white-tailed deer were harvested in the study area; over 30,000 hunter days were spent in the sport (Appendix 7).

III. D. 2. Upland Game Birds

Five major species of upland game birds were hunted in the study area: wild turkey, bobwhite, ring-necked pheasant, mourning dove, and ruffed grouse. While ruffed grouse are hunted in the study area, no data is available.

Bobwhite - The bobwhite is most abundant in shrubby habitat, pastures, and ungrazed grasslands (Graber and Graber, 1963), where it nests on the ground (Edminster, 1954). Approximately 95,000 bobwhites were harvested in the study area; over 46,000 hunter days were expended in this sport (Appendix 8).

Mourning Dove - The mourning dove, a seed-eating bird, is most closely associated with semi-forested regions (Edminster, 1954, Preno and Labisky, 1971); it is also attracted to harvested cropland and marshes (Graber and Graber, 1963). The mourning dove is not hunted in Iowa or Wisconsin. Approximately 62,000 doves were harvested in the study area; over 23,000 hunter use days were expended in this sport (Appendix 8).

Ring-necked Pheasant - This bird occurs in open, natural grasslands and in open farmlands bordered by naturally forested areas (Aldrich and Duvall, 1955). Nests are most commonly built in hayfields (Preno and Labisky, 1971) but are also found in roadside ditches (Joselyn et al., 1968). Most of the study area is outside the prime habitat of this game bird. An estimated 71,000 pheasants were taken in the study area; over 36,000 hunter days were expended in this sport (Appendix 8).

Wild Turkey - This species is associated with large tracts of forested land where it feeds upon macroinvertebrates, greens, acorns, and other seed. Nesting occurs on the ground at the forest edge near open areas (Edminster, 1954). Harvest and use data are available only from Missouri. The turkey is not hunted in Wisconsin. Approximately 80 birds were harvested in the study area; over 1,350 hunter use days were expended in this sport (Appendix 8).

III. D. 3. Waterfowl

The study area lies within the Mississippi River Flyway, which "draws birds from clear across the Arctic part of the continent..." (Glover, 1964). Waterfowl hunters utilized sandbars and islands in the Mississippi River or conservation areas managed for controlled hunting. During the season, 117,000 ducks and geese were harvested in the study area; over 86,000 hunter days were expended in this sport (Appendix 9).

III. D. 4. Fur Trapping

The backwater sloughs and bottomland forests associated with the floodplains of the Upper Mississippi River provide preferred habitat for raccoons and other river basin furbearers. Bottomland species of greatest economic importance included raccoon and muskrat; additional furbearers of lesser economic importance were fox, opossum, mink, beaver, skunk, weasel, coyote, bobcat, and badger. Badger cannot be trapped in Wisconsin. From the data available, a minimum of 103,000 user days were spent harvesting furbearers.

Raccoon - In addition to being the most economically important furbearer, the raccoon was also one of the most abundant in the study area. Bottomland forests adjacent to rivers, lakes, swamps, and backwater sloughs provided excellent habitat. In the study area, approximately 66,600 raccoons were harvested for an estimated value of approximately $1,243,000 (Appendix 10). These values include hunting data as well as trapping data.

Muskrat - The muskrat, the most abundant furbearer in the counties of the study area, prefers habitats with slow-moving water, abundant shoreline vegetation, and stable water levels. When suitable marsh habitat is not available, muskrats construct dens along river banks, drainage ditches, and streams. In the study area, approximately 30,000 muskrat were harvested for an estimated value of $141,000 (Appendix 10).

Fox - Generally, their habitat consists of forest interspersed with open brushy areas and farmlands. In the study area, approximately 3,100 fox were harvested for an estimated value of $121,000. These values include hunting data as well as trapping data.

Opossum - The opossum occupies a variety of habitats, reaching its greatest density in the river bottoms. In the study area, approximately 1,900 opossum were harvested for an estimated value of $3,900 (Appendix 10).

Coyote - Generally, the coyote is a very versatile animal. They have been able to increase in numbers as man has altered the environment. In the study area, approximately 6,600 coyote were harvested for an estimated value of $115,100. These values include hunting data as well as trapping data.

Mink - The mink is common is a variety of habitats with adequate cover and permanent water. In the study area, approximately 400 mink were harvested for an estimated value of $5,000 (Appendix 10).

Beaver - Following near-extirpation in the early 1900's, beavers were successfully reestablished throughout the study area. In the study area, beavers commonly occupied burrows constructed in the steep banks. In the study area, approximately 110 beavers were harvested for an estimated value of $770 (Appendix 10).

Skunk - Although skunks were quite common throughout the study area, they represented only a small fraction of the fur harvest due to their unpopularity as a fur source and due to low pelt values. More striped skunks were harvested in the area than spotted skunks. In the study area, approximately 400 skunks were harvested for an estimated value of $900 (Appendix 10).

III. D. 5. Nonconsumptive Uses

Nature interpretation, wildlands appreciation, photography, hiking, and wildlife observation are recreational activities considered nonconsumptive uses of wildlife resources, as they do not involve the "harvest" of any animal. The economic value of such activities is difficult to assess, and little research has been done, largely due to the dominant interest in the recreational aspects of hunting and fishing. Information on this type of use was unavailable except for the U.S. Fish and Wildlife Service refuges.

III. E. ENDANGERED AND THREATENED SPECIES

III. E. 1. Causes for Decline

The loss of animals and plants is one of the most compelling of today's environmental problems. It is no longer a case of a species lost here and a species lost there. All over the world many have become extinct or are facing extinction. During the past century and a half, for example, more than 200 species of animals have disappeared--nearly 50 in the United States alone. Now, in 1979, over 1,000 animals are in serious trouble throughout the world.

Factors leading to the decline of particular species can generally be categorized under the general headings of habitat loss, habitat degradation, exploitation, inherent rarity, and unknown. These factors and the role they play in the extinction or extirpation of species is described below.

Although one or more of these factors are assigned as the reason for a decline in the various species, it must be kept in mind that the cause for decline is not often clear cut. It is also obvious that many of the factors are inter-related and that distinctions of primary reasons for the decline are impossible. Finally, it should be mentioned that what we humans perceive as the cause for decline may not actually be the problem which the particular species is responding to. They may perceive subtle changes which are unknown to man.

Habitat Loss - A species selects a particular habitat (or habitats) to fulfill its needs for food, space, nesting or mating territory, migratory routes, or hibernacula. Destruction or removal of that habitat will reduce the number of animals a unit area of land or water can maintain. The more critically a species depends on a particular habitat, the more the removal of that habitat affects the species in question.

Outright loss of habitat is one of the most commonly given causes for decline of endangered species. With the intensive farming and riverside developments in the study area natural, undisturbed habitat is at a premium. Habitats of every type have been plowed up, burned, buried, replanted, cut, developed, and used and abused in every possible manner.

The extent of loss is also important. Some species (large carnivores, for example) often require extensive tracts of their preferred habitat. Other species may be able to maintain themselves in smaller units of this habitat but their overall numbers will be reduced. Those habitats that were never

very abundant or generally take up less space (bogs, caves) are particularly important. The loss of even a few particular sites of these habitats may represent a loss of a great percentage of the total.

Habitat Degradation - Even if habitat is not lost outright, changes in the habitat or adjacent lands may reduce its quality to such an extent that it is no longer fit for the species. A moderate size marsh or hardwood forest may appear perfectly capable of supporting a particular species; however, the animal isn't found there. The answer may lie in the suburban development nearby or the pollution source upstream.

The problem of habitat degradation is not immediately obvious sometimes. It may be a gradual process as an area shifts from prairie to farm to housing development. Also some species may be better able to cope with the problems posed by man's activities. Habitat degradation is one factor that is often detected by animals long before man would consider it a problem. As these species are so dependent on their environment for all their needs, they may more quickly react to subtle changes in the quality of their environment.

Listed below are various categories under the heading of habitat degradation. Some of these are inter-related, even the result of one another. However, all these have been cited separately as causes for decline.

Pesticide Poisoning - The use of a great variety of chemicals to kill unwanted insect, plant, and vertebrate pests has a greater result than most anticipated. The effects have shown up in such forms as reproductive failure, metabolic aberations, and decline in prey species.

Changes in Water Quality - This factor is actually a result of other factors. However, it was noted so frequently as the cause of decline for species in the study area, it is given specific mention here. Water quality changes include alterations in temperature, turbidity, and amount of dissolved substance.

Proximity to Development - Outside of the actual removal of habitat for man's activities, the direct physical effects of development may not be obvious. The increase in industrial or residential use adjacent to favorable habitat increases the sources of air, noise, and water pollution. One or more of these may combine to reduce the quality of that habitat. Many species simply cannot tolerate the effects of man's activities such as increased automobile traffic, emissions from smoke stacks, or disturbances by humans or their pets. Normal cycles are disrupted as the "natural" character of an area is lost. Nesting or mating may be impaired, food sources dwindle,

and actual space to move about is lost. In addition, development tends to fragment the natural habitat which is particularly critical for animals which require several habitats in proximity.

General Agricultural Practices - At one time, it was thought that farmland was the future haven for wildlife. That was when large amounts of land were used for pasture, rotation schemes had sizable tracts in clover, and every farmer had woodlots and grown-up fencerows. The move to increased planting of row crops, clean farming, fall plowing, and cutting or pasturing of woodlots has changed the value of agricultural land to wildlife.

Construction of Navigational Structures - There are two major effects of this activity. First the river changed from a flowing stream with all the associated hydrologic processes to a series of lake-like pools. Secondly, the dams block the migration routes of some fish.

Physical Changes in Streams - This is often the direct cause for changes in water quality as described above. This category includes changes in such characteristics as bottom type, flow, velocity, shore topography, stream configuration, and depth. Also included here is the loss of aquatic vegetation. These changes are the result of activities such as channelization, dredging, bank development, levee construction, and dam building.

Exploitation - In the past certain commercially desirable wildlife species have been slaughtered in large numbers through acts of market hunters. These huge slaughters would have appeared to doom many animal species. However, as the numbers decline, the profit in taking them declines because of increased effort involved in harvesting often leads to a remnant population being left to reproduce if the proper quality habitat is available.

For many years the huge market hunting operations were thought to be the main reason behind the extinction of the passenger pigeon. However, information available suggests that the birds should have been able to survive this in limited numbers. Changes in land use and a very low reproductive potential are now given equal weight by some as factors for the extinction of this species.

All in all, the taking or harassment of species whether for income, sport, or personal desires, when associated with habitat destruction and alteration occurring concurrently, contribute to the decline of a species.

The following are the four types of exploitation mentioned as factors leading to the reduction of numbers in several species.

Sporting Uses - This refers to the taking of animals by hunting, fishing or trapping primarily for recreation. Although the animals taken or by-products of them are often used as food or for income, this harvest is not on the level of commercial operations. Hunting and fishing are for the most part directed at a few species of larger mammals, birds, or fish.

Commercial Use - This refers to the harvest of animals primarily to produce an income. These animals may be used as food, clothing, pets, or for research purposes. This harvest is often on a large scale and may be locally devasting to a population. The obvious case in the study area is the commercial mussel fishing operation.

Harassment - This is usually a direct activity involving the destruction of an animal for no other purpose than a general dislike of the animal. Sometimes there may be no purpose behind the action at all. An example is the disturbance or destruction of bats while roosting in caves. This category also includes activities taken against animals that are regarded as pests or harmful to man.

Private Collecting - Many species, particularly those prized because of their rarity or beauty, are collected by individual hobbyists. The fact that very rare species are especially desirable only compounds the problem for these species.

Inherent Rarity - Some species may simply have been rare even before European man arrived. Natural processes of climatic and vegetational change may have held these populations in check or even caused their decline. This is not to say we should simply write off their decline as the course of nature. Often man's activities have aggravated the problems these species face. The fact that they are rare makes them unique for several reasons. These species may be indicators of an equally rare habitat. Also species that are naturally rare are often the first to decline and may serve as an early warning of the fate of other species. Finally, uncommon animals hold a certain fascination for the scientist and layman alike.

The reasons most noted for rarity in the study area include:

Historical Rarity - This describes a species that, to the best of our knowledge, has existed in low numbers for some time. This may be due to the fact that its

requirements have never been well met in the study area. However, it may be common elsewhere in its range. Another factor may be that this species simply does not occur in large numbers even in favorable habitat. Species may maintain low abundance because of low reproductive rate, the need for large territories, or other reasons.

Range Periphery - Species normally occur in lower numbers at the edge of their range than they do in the main part of the known range. Since they are already facing some limiting factor(s) in this peripheral area, any stress put on them throughout their range will first be noticed at the extreme edge of their range. It is expected that species reaching range limits in the study area may decline even while populations in other areas remain stable or even increase.

Cyclical Populations - Certain species show cyclical changes in population levels. These trends may just now be coming to light after long years of continuous observation. The reasons for these cycles are often poorly understood. So, a decline in the numbers of a species in a particular area may just be an expression of a naturally occurring phenomenon. However, we must guard against enhancing the decline through habitat degradation or destruction. At the low points in population levels, these species are particularly vulnerable to changes.

It should be mentioned that in these inherently rare species, the low numbers may represent a low-level, but stable population.

Unknown - There are some endangered species for which we cannot or have not been able to determine the cause for decline. It may be a combination of all the factors that masks the reason, or we may not know enough about the ecology of the species to know what factors would have an effect. Very few species in the study area have the reason for decline undescribed. In most cases the experts have come to some sort of conclusion of the factors involved in the decline. There is the chance they are incorrect.

III. E. 2. Federal and State Protection

Since the passage of the Federal Endangered Species Act of 1973, all of the states within the study area have either strengthened or established state endangered species acts. The states-Illinois, Iowa, Missouri and Wisconsin-include the species listed as endangered and threatened under the Federal Endangered Species

Act and also the species considered endangered and threatened within their own boundaries. In some cases the species listed as endangered or threatened within a given state may be extremely abundant throughout its native range and are only on the extreme edge of its natural range within the study area. The lake sturgeon is considered threatened in Illinois and Missouri but is neither considered threatened nor endangered in Iowa which has a natural boundary-the Mississippi River.1/

Federal - Under Federal law there are several acts which offer protection to endangered and threatened species: (1) Act of 1973, as amended, (2) the Lacey Act and (3) the Bald Eagle Protection Act.

The most recent listing of Endangered and Threatened Wildlife and Plants in the Federal Register is January 17, 1979 (44 FR 3636-3654). On the Federally listed endangered species list, seven species occur within the GREAT II study area (Appendix 12). These species are the Indiana bat, bald eagle, American peregrine falcon, Artic peregrine falcon, Higgin's eye pearly mussel, fat pocketbook mussel and a plant, the northern wild monkshood.

There are presently no Mississippi River fish species included on the federal list of endangered species.

State of Illinois - The Illinois Endangered Species Act was passed in 1973. The Act established the Endangered Species Protection Board which is dedicated to the protection of endangered and threatened species in Illinois.

A list of Illinois endangered and threatened species within the study area can be found in Appendix 13.

State of Iowa - The State of Iowa, on June 3, 1975, passed a bill entitled "Management and Protection of Endangered Plants and Wildlife".

A list of those endangered and threatened species within the study area can be found in Appendix 14.

State of Missouri - In 1972, the Missouri General Assembly passed an Act charging the Department of Conservation with establishing a list of animal species considered endangered and providing certain statutory protection for them.

A list of those endangered and threatened species within the study area can be found in Appendix 15.

State of Wisconsin - Wisconsin has recognized the importance of protecting its declining wildlife since 1971, when it undertook a review of its native non-game animals. The Wisconsin Legislature passed the State's Endangered Species Act in 1972, calling

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1/ Note: All lists of federal and state endangered and threatened species were current for January 1980. For the most up to date information, the U.S. Fish and Wildlife Service or the state conservation agencies should be consulted.

for the development of a list of endangered wildlife and mandating protection of state listed species as well as those on the Federal list.

A list of the Wisconsin endangered and threatened species within the study area can be found in Appendix 16.

III. F. State and Federal Refuges and Management Areas

Approximately 105,000 acres of land and water are managed by state and federal agencies for wildlife production and protection (Table 9). This accounts for 36 percent of the floodplain acreage (i.e. the area between levees or railroad embankments) in Pools 11-22. The problems faced in managing unprotected floodplains for wildlife are a cause for concern. These areas are subjected to the negative effects of other river-related activities such as navigation, dredging, barge fleeting, and intensive public recreation. Also floodplain wildlife management personnel do not have the intensive management techniques available to upland managers because of the restrictions and requirements involved in making alterations in the floodplain of navigable waters. Due to these problems, the quality of these refuges for wildlife may be in jeopardy.

Most of these lands are owned by the U.S. Army Corps of Engineers. During construction of the 9-foot channel project, the United States Government acquired most of the land between levees or railroad embankments in all pools except 15, 19, and 20. River lands in Pools 19 and 20 are privately owned by the Union Electric Power Company. This is the result of the construction of Lock and Dam 19 at Keokuk in 1913. Pool 15 contains mostly land that is within the corporate city limits of the Quad Cities Urban area.

According to Section 7 of the 1954 agreement between the Bureau of Sport Fisheries and Wildlife (precursor of the U.S. Fish and Wildlife Service) and the U.S. Army, Corps of Engineers, a General Plan for fish and wildlife management shall be developed jointly by the Corps, Bureau, and appropriate state agencies for all project lands and water where management for fish and wildlife purposes is proposed. The administrative details for implementing the General Plan are a part of the Cooperative Agreement made between the Department of the Interior and Department of the Army in 1963. Under this agreement, the Department of the Army has made available to the Bureau (U.S. FWS) 83,712 acres of land and water areas for the conservation, maintenance and management of wildlife resources.

TABLE 9

Approximate Acreage of Land and Water Managed by Federal and State Resource Agencies

	MANAGEMENT AGENCY							
	U.S. FWS		Iowa		Illinois		Missouri*	
Pool	U.S. FWS Owned	Corps Owned*	State Owned	Corps Owned*	State Owned	Corps Owned*		Total
11	6,800	11,020	-	-	-	-	-	17,820
12	852	8,373	-	-	-	-	-	9,225
13	6,888	22,511	2,722	827	-	-	-	32,948
14	1,079	5,349	772	342	-	-	-	7,542
15	-	-	-	-	-	-	-	-
16	-	-	-	1,548	600	4,492	-	6,640
17	-	4,366	30	2,931	-	1,313	-	8,640
18	-	1,400		4,314	319	2,872	-	8,905
19	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-
21	-	4,831	-	-	-	2,556	747	8,134
22	-	-	-	-	-	3,479	1,789	5,268
TOTAL	15,619	57,850	3,524	9,962	919	14,712	2,536	105,122

* Lands under Cooperative Agreement with U.S. FWS and Corps.

III. F. 1. Federal Lands Managed by the U.S. Fish and Wildlife Service

The U. S. Congress recognized the high value of the study area for fish and wildlife by establishing two national wildlife refuges. These are the Upper Mississippi River Wild Life and Fish Refuge and the Mark Twain National Wildlife Refuge.

In addition to the National Wildlife Refuges established and the co-op lands, the U.S. Fish and Wildlife Service (FWS), under the Sikes Act, also has a role in the management for wildlife on the 6,500 acres of backwaters and islands owned by the Department of the Army in Pools 12 and 13 (Savanna Ordinance Depot). A Cooperative Plan Agreement for the Conservation and Development of Fish, Forest and Wildlife Resources on the Savanna Army Depot has been approved by the Department of Defense, Department of the Interior and the State of Illinois effective September, 1978. It provides for a general inventory review of fish and wildlife resources; the development, protection and improvement of habitats to secure optimum conditions that do not conflict with the primary mission of the installation; development of a long range (5 years) Fish and Wildlife Management Plan; management of the installation so as to protect and control the watersheds, soil, beneficial forest and timber growth and beneficial vegetative cover as vital elements of this fish and wildlife program; hunting, fishing and trapping in accordance with State and Federal laws governing same. As discussed below, the State of Illinois has hunting management authority on this area.

Upper Mississippi River Wild Life and Fish Refuge - The UMR occupies 62,800 acres in Pools 11-14. Approximately one-quarter of this acreage was purchased by the FWS between the establishment of the refuge in 1924 and the construction of the locks and dams in the 1930's. The rest of the refuge is on Corps-owned cooperative agreement lands.

Management objectives (as defined by the Upper Mississippi River Wild Life and Fish Refuge Act, June 7, 1924) are:

(a) to maintain the lands and waters as a refuge and breeding place for migratory birds; (b) to maintain the lands and waters as a refuge and breeding place for other wild birds, furbearers, other wildlife, and conservation of wildflowers and aquatic plants; and (c) to maintain lands and waters as a refuge and breeding place for fish and other aquatic

Mark Twain National Wildlife Refuge - Four divisions of this refuge have been established on Corps-owned cooperative agreement lands in Pools 17, 18, and 21. The primary management objectives of the Mark Twain NWR are (a) to provide migrating waterfowl with food, water and protection during the fall and spring months; (b) to improve and maintain existing habitat for the production of wood ducks; (c) to provide food, water and protection for wintering waterfowl; (d) to maintain balanced populations of all resident wildlife species; (e) to

maintain portions of the refuge river bottom habitat in its natural, virgin state; and (f) to provide limited day-use recreation where and when such activities are compatible with primary objectives.

Management activities on both the Upper Mississippi River Wild Life and Fish Refuge and the Mark Twain National Wildlife Refuge have been limited by several factors. Both refuges are very large and lack the resources and legal authorities to undertake extensive alterations. Most of the refuge property is subject to annual water fluctuations. Additionally, management activities in this floodplain would require the obtainment of necessary state and federal permits and compliance with the National Environmental Policy Act of 1969, Executive Order 11988 (Floodplain Management) and Executive Order 11990 (Wetland Management).

III. F. 2. State and Federal Lands Managed by State Conservation Agencies

Wisconsin - No lands are owned or cooperatively managed by the state of Wisconsin within the GREAT II area.

Iowa - The Iowa Conservation Commission manages 13,486 acres in Pools 13, 14, 16, 17, and 18. Their management objectives are the production and harvest of waterfowl as well as total resource maintenance.

The Green Island Wildlife Area in Pool 13 contains 2,722 acres of federal lands and 827 acres of state-owned lands. The Princeton Wildlife Area contains 1,114 acres of which 722 are federally owned. The Lake Odessa (4,179 acres) and Mississippi River islands and shoreline (4,646 acres) units are both Corps owned lands in Pools 16, 17, and 18 that are managed by the Iowa Conservation Commission.

Illinois - Just above Lock and Dam 12, the Illinois Department of Conservation leases approximately 500-600 acres from the Department of the Army's Savanna Proving Grounds. (See Section III. F. 1. for more on this cooperative agreement.) The only management on this area is to regulate the number of duck blinds. The 600 acre Andalusia Refuge on Andalusia Island in Pool 16 is owned by the state and is managed strictly as a waterfowl refuge, i.e., portions of it are closed to hunting during the waterfowl season.

Pool 18 contains two areas owned and managed by Illinois. Immediately above Lock and Dam 18 is the Oquawka Refuge, occupying 319 acres. Management is primarily for waterfowl and includes such techniques as wood box installation and leased farming with crop shares left in the field. Big Timber State Forest, south of Keithsburg, includes part of the Mississippi River floodplain inundated during lock and dam construction. Although the area is primarily devoted to use as a demonstration area for forestry practices, hunting for all species is allowed on the entire area.

In addition to the above, the Department of Conservation manages 14,712 acres of Cooperative Agreement lands in Pools 16, 17, 18, 21, and 22. The Department's management objectives are to provide a refuge for fish and wildlife and to provide access and enhance opportunities for outdoor recreation including camping, hiking, boating, hunting, fishing, trapping and wildlife observation. The only management by the state is regulation of the number and placement of duck blinds.

Missouri - There are no state owned management areas in the GREAT II area. However, the Department of Conservation does manage 2,536 acres of Cooperative Agreement lands in Pools 21 and 22. Management objectives on these lands include the control, restoration, conservation and regulation of bird, fish, game, and forestry.

IV. FISH AND WILDLIFE RESOURCES - PROJECTED CONDITIONS

IV. A. AQUATIC RESOURCES

IV. A. 1. Mussels

The status of mussels in the year 2025 will depend on how factors influencing and controlling mussel populations change. If control of point sources of water pollution continues at the same level or increases, populations will accordingly stay the same or increase, especially in areas that have been heavily impacted. However, the cumulative impacts of low level pollution from additional industry and increasing population in the area may lead to increasing impacts on mussels, reducing mussel populations.

Agricultural runoff including silt and chemicals will, if uncontrolled, probably increase as increased demands are made for food production. The impact of this pollution could seriously impact mussel populations.

Harvesting of mussels should be self-limiting because of industry size limitations. Unless size limits are substantially reduced or there is an increase in the use of damaging mechanical dredges, there should be little lasting impact on mussel populations.

Mussel populations are subject to changes in both number and diversity of fish populations. Changes in fish populations will directly impact mussel populations. If we assume off-channel areas will continue to fill at the current rate, fish host availability for mussel glochidia will decrease. However, any observable changes would be slow, since the life span of mussels, depending on species, varies from 10 to perhaps 40 or more years.

In summary, the combined impact of increased industrialization, agricultural runoff, and other impacts may severely reduce overall population and/or species diversity.

IV. A. 2. Fish

The future of the fishery if no action is taken on GREAT

predictably is an extension of the past. The Corps of Engineers (1974) predicts "sedimentation will fill in many marshes, sloughs and other secondary watercourses and create new ones until the channel cross-section is reduced to the original capacity before dam construction" - the river will become riverine once more. But, this "new" river will not be like the pre-project river - it will have one main navigation channel with few side channels and virtually no lakes, ponds or sloughs, because wing dikes, closing structures and sedimentation will have closed off the valuable backwaters, directing flow into the main channel. The fishery provided would be much like the fishery of the present river below St. Louis, where most side channels, lakes and sloughs have been eliminated. With the loss of habitat diversity, fish diversity decreases. Largemouth bass, crappie, northern pike, bluegill, rock bass, warmouth, paddlefish and bullhead species would be much reduced or gone. Commercial catches of buffalo and freshwater drum would decline. As more of the river is concentrated into the main channel, erosion of banks become more severe and bank protection with riprap necessary. Riprapping of the banks eliminates bank holes and cover used by catfish for spawning, thus affecting catfish populations. With increased bank erosion adding to the sediment load and the loss of pools for sediment deposition, the river would be more turbid resulting in greater sediment deposition in the quiet bank holes and cover areas used by catfish for spawning, further impacting abundance. Without backwater areas to carry part of the flood flows, water levels would fluctuate much more drastically and rapidly. In summary we would completely lose any benefits provided to the fishery by the initial dam construction as well as losing much of the original river fishery.

IV. B. PROJECTED UTILIZATION OF FISH RESOURCES

IV. B. 1. Sport Fishery

With a decrease in available habitat, sportfishing will be largely restricted to tailwaters and main channel borders. Primary species in the creel will probably be drum, carp, channel catfish, and white bass. In addition to a change in species composition, the catch rate will likely decrease.

Fishing pressure will increase as the population expands. Pressure will also temporarily increase with improved or increased access to many pools.

Losses in fishable habitat and declining angler success may be offset by the increase in pressure. Total harvest will not decrease significantly and may in fact increase. However, the quality of the angling experience and fish caught will deteriorate.

IV. B. 2. Commercial Fishery

Mussels One of the main factors controling mussel populations in the UMR is the availability of fish hosts for the glochidial larval phase of a mussel's life cycle. Current knowledge (Fuller, 1979) indicates the black sandshell is the only commercially harvested mussel which is host specific. A reduction in off-channel habitat will significantly decrease fish species diversity in the Mississippi River. A reduction in diversity will reduce glochidial host opportunities and subsequently mussel populations. Since mussels have a relatively long life span, a noticeable change in the commercial mussel harvest may be negligible by 2025.

Fish Commercial harvest of the 314 miles of the middle river (Lock & Dam 26 to the Ohio River) can provide us a view of what could happen to the commercial fishery of the Upper Mississippi River if off channel habitat degradation continues.

Most of the fish habitat of the middle river can be classified as main channel and main channel border. Tailwater habitat exists only below Lock & Dams 26 and 27. Many of the side channels are provided with water only during periods of high river stage. Sloughs are scarce as are river lakes and ponds (Rasmussen, 1979). Carp, buffalo species, channel catfish and freshwater drum dominate the fishery.

IV. C. WILDLIFE RESOURCES

IV. C. 1. Birds

Game species and non-game species are dependent on appropriate habitat for survival and reproduction. The loss and degradation of habitat to industrial, residential, and recreational development will increase. Environmental quality will determine species productivity and survival.

While habitat destruction is being slowed by local, state, and

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federal laws, subtle changes in air and water quality are more difficult to detect. The long and short term effects of these environmental contaminents, including oil, chemical, and other hazardous materials, on birds are not easily defined but should be monitored for documentation.

IV. C. 2. Mammals

Mammalian populations on the Mississippi River will respond to major environmental influences including (1) long and short term changes in habitat and (2) degree of commercial or sport harvest utilization. As hunting and trapping of game species is closely regulated, changes in habitat must be recognized as the most significant factor affecting status of mammalian species in the future.

To project mammalian resource status, it is necessary to anticipate probable habitat change, based on current management of the river. Population response to these changes, by mammal groups, can then be predicted. If present conditions of the river continue, it is generally agreed that:

> Quantity and interspersion of off-channel wetlands will decrease.
>
> Quality of remaining off-channel wetlands will continue to be reduced.
>
> Succession of terrestrial vegetation, particularly on higher elevations, will continue.

IV. C. 3. Aquatic Mammals

Habitat changes anticipated on the river will more adversely affect aquatic mammals than other groups. Continued loss of backwater habitat through siltation will reduce carrying capacity for muskrat. Emergent vegetation, an important component for quality muskrat habitat, will be reduced. Muskrats will exist as low density, bank denning populations characteristic of an entirely riverine environment. Adverse impacts of extreme water level fluctuation coupled with a reducing quality of habitat will suppress population numbers. Response of beaver populations to the river environment will not be as great as muskrat. Food resources for beaver should be sufficient to maintain population levels. Continued extreme fluctuation of water elevations, particularly in winter and early spring, aggravated by clean tillage and intensive row-cropping in the watershed, will remain a problem.

Populations of river otter, even though protected from harvest, cannot be expected to increase, or expand in range, due to water quality problems and loss of wetland habitat. Raccoons are expected to remain abundant along the river but population density may be adversely affected by the loss of shallow water wetlands.

IV. C. 4. Upland Mammals

Many upland mamals will not be greatly affected by changes in wetland habitat, but will respond to changes in successional stages of terrestrial vegetation. Deer will remain common although increasing age of timber stands may reduce available browse. Deer use on the river may become more seasonal with defined movements of deer from river lands to adjacent, private farmlands during winter months.

Squirrel populations will likely fluctuate with mast yield as related to tree species composition, age of stand and environmental factors such as flooding. Quality of squirrel habitat is likely to increase due to advancing age of the timber. Canid populations (red fox, gray fox, coyote) may be more responsive to broader environmental concerns, as opposed to characteristics of river habitat only, than most other species. Occurrence will likely remain common, Considering loss of woodland occurring on private lands, the river's timber habitat may become increasingly important to gray fox. Loss of productivity, with reductions in shallow water wetland acreage and unstable populations of small rodents and rabbits due to flooding, may limit habitat value of river lands for this group. Flooding limits production of mice and voles on many of these lands. Population density probably fluctuates widely but seldom at high densities typical of more stable habitats. Several members of this group are capable, however, of surviving flooding by utilizing trees. More stable populations are probably typical of riparian habitats and levees. Low populations of these mammals contribute to a generally poor habitat for Mustelidae including weasels and skunks.

The woodland habitat with interspersed watercourses typical of the river, can provide and attractive area for various bat species. Habitat quality is expected to decrease in future years as interspersion of water openings within the timber become less frequent. Food production from shallow water areas will also be reduced.

IV. D. Projected Utilization of Wildlife Resources

IV. D. 1. Hunting

Opportunities available for hunting and trapping in future years, without implementation of GREAT II recommendations, will be a product of interaction of several variables including:

Productive capacity of the habitat for harvestable wildlife species.

Demand for hunting and trapping experiences.

Availability of lands and waters for these activities.

Degree of tolerance among competing user groups of the river's resources.

Assuming that (1) recreational demand for hunting and trapping will continue, and that (2) river lands will continue to be available for these pursuits, habitat and population characteristics will, therefore, largely determine opportunities available for hunting and trapping.

Habitat changes anticipated in future years, if present management continues, include reduced quantity and interspersion of cover types. Wetland acreage will diminish as sedimentation continues to fill marshes, sloughs and watercourses. Terrestrial habitat will succeed to more advanced stages of bottomland hardwoods. The system will be characterized as riverine, but without characteristic "braiding" of side channels and backwaters creating the more desired interspersion of varying cover types.

Waterfowl Harvest Opportunities Hunting opportunities for waterfowl will decrease due to loss of wetland habitat. Major concentrations of waterfowl will only be characteristic of river reaches adjacent to off-river, managed wetlands, where needed habitat can be assured, or on some large open-water areas with resources attractive to diving ducks. Hunting opportunities will also decrease due to direct loss of wetland acreage available for waterfowl hunting. Boat access to any remaining hunting sites may be difficult.

Wood duck production on the river will also decrease due to lowered values of production habitat.

Small Game Harvest Opportunities Opportunity for total squirrel harvest may increase due to an expanding timber resource and maturation of stands. Flooding, which is likely to become more severe, will preclude much opportunity for small game population growth and significant hunting recreation. Hunting opportunity for woodcock will likely decrease with advanced timber growth and less acreage of early succession woodland communities.

Big Game Harvest Opportunities Deer hunting opportunities will not be greatly affected. River woodlands will probably be an important habitat component for local populations, at least seasonally. Hunting opportunity will remain at current levels. Huntable populations of wild turkey may become established on more river lands. Populations, and recreational utilization, however, may be severely restricted by direct and indirect effects of flooding.

IV. D. 2. Trapping

Furbearer Harvest Opportunity Furbearer harvest opportunity will parallel the fate of waterfowl hunting. Less wetland habitat will reduce populations of aquatic furbearers. Harvest potential will be greatly reduced, especially for muskrat.

Harvest potential for terrestrial furbearers such as fox and coyote will fluctuate more due to off-river considerations than changes in river habitat. Projected habitat quality for these furbearers will not be greatly altered from present conditions.

IV. E. ENDANGERED SPECIES

Use of land for agriculture, transportation, residential and industrial property and recreation should all increase. This will decrease the amount of land left in a natural undisturbed state and degrade remaining habitat.

IV. E. 1. Habitat Loss

Shallow aquatic habitat may be spared from encroachment due to increased awareness of its importance and legislative mandates but sedimentation will continue. Woodlands, prairies and bogs will decrease. The limited number of caves will be identified for their importance and preserved or protected from disturbance. Cliffs and wooded bluffs will be spared from intense use, however, their scenic appeal will increase recreational use making them unsuitable for some species.

In the river area the general trend should be towards a more uniform channel in terms of hydrology and vegetation. Effects of siltation and channel maintenance will lead to a reduction of backwaters.

IV. E. 2. Habitat Degradation

The use of some of the most lethal pesticides has been banned, so their effect should diminish. However, the effect of pesticides currently in the soil, water, plants or animal tissue is unknown. Controls on sources of air and water pollution are being improved. However, an increase of pollution sources may offset these actions. Construction along and in streams will be closely scrutinized to minimize impacts. The spread of urbanized areas will increasingly impact isolated areas.

IV. E. 3. Exploitation

Exploitation will continue to endanger the existence of many species that are not presently protected. Commercial and sport harvest regulations will attempt to keep their harvest within the limits imposed by productivity of the species. However, productivity is expected to decline as habitat quality decreases.

IV. E. 4. Improvements

On the positive ledger, there are several factors which should lead to the retention and improvement of habitat for many species. Increased awareness of their plight, monitoring of status, Federal and State legislation, and reasearch on their ecology will allow resource managers to preserve needed habitat.

V. EXISTING CONDITIONS FOR EACH POOL

The following is a general description of the fish and wildlife resources and their use in each pool of the study area. The acreages quoted have been summarized from the "Upper Mississippi River Habitat Inventory" (Hagen, Werth and Meyer, 1977). Areas depicted by the symbol G_d in the Inventory, are for the most part levees covered largely by grasses. For this appendix, these areas were combined with terrestrial herbaceous vegetation. In the Inventory, acreages noted for the main channel include the main channel border habitat type. To provide an acreage figure for both of these habitats, it was assumed the main channel habitat (i.e. navigation channel) has an average width of 450 feet. The inventory's description of lakes, ponds, sloughs, and side streams do not correspond well enough with the UMRCC habitat descriptions to assign them specific acreages. However, the area encompassed by the habitat types in both descriptions is the same (i.e. all off-channel area with the exception of side channels and the main channel border). For purposes of this report, these acreages were summed and noted under river lakes and ponds, sloughs, and side streams and submergent and floating vegetation.

Information on mussels was taken from "A Survey of Upper Mississippi River Mussels" by Edward Perry in UMRCC Fisheries Compendium (Rasmussen, 1979) and Fresh-water Mussels (Mollusca: Bivalvia: Unionidae) of the Upper Mississippi River: Observations at Selected Sites Within the 9-Foot Navigation Project on Behalf of the United States Army Corps of Engineers (Fuller, 1978). Commercial harvest data and values for mussels were derived from information supplied by the state resource agencies.

Expenditures per angling and hunting days, exclusive of license cost and fees, were obtained from the 1975 National Survey of Hunting, Fishing and Wildlife Associated Recreation (Anonymous, 1977). Angling use days were derived from Recreation Use Projections and Needs Report, (GREAT II Recreation Work Group, 1980). Hunter use and harvest data was derived from information supplied by the federal and state resource agencies. Recreational hunting data is compiled on a statewide, county or area basis. Converting this information to reflect harvest and activity days in each pool is difficult and the results are tenuous. Activity days and expenditures (in 1975 dollars) were rounded off to the nearest thousand.

Commercial harvest data and values for fish and wildlife are derived from 1978 data compiled by the UMRCC and information supplied by the federal and state resource agencies, respectively.

The list of federally endangered species and state endangered and threatened species was compiled from descriptions provided by federal and state resource agencies and was current for January 1980.

Information on the size and locations of refuges and management areas was supplied by federal and state resource agencies.

V. A. Pool 11

Terrestrial habitat types and their acreage include: aquatic marshland (2,100 acres), agricultural lands (500 acres), sand and mud (100 acres), dredge material (200 acres), and developed lands (400 acres).

Aquatic habitat types and their acreage include: main channel (1,700 acres), main channel border (4,100 acres), side channel (500 acres), sloughs-side streams, river lakes and ponds and submergent and floating vegetation (11,300 total acres). Levee bound backwaters are included under sloughs and streams.

No formal studies of aquatic insects and other invertebrates have been conducted in this pool, however, certain species of fish are indicators of certain types of invertebrates. Commercially harvested bigmouth and small buffalo, river carpsucker and paddlefish indicate the presence of large zooplankton populations of Cladocera and Copepoda. The pool is considered to have a species rich and populous mussel fauna. Mussel records reveal the presence of 25 species in this pool. Commercial harvest of mussels is negligible.

There have been 85 species of fish recorded in this pool. Of these 34 are considered common. Fish utilize every available portion of the pool. However, it is the off channel areas which provide the essential spawning, rearing, resting and feeding habitat for the majority of species.

Sportfishing provided 355,000 activity days or 37 percent of the total recreational activity. This activity contributed approximately $3.2 million (1975 dollars) to the economy. Species most actively sought by fishermen were crappie, bluegill, freshwater drum, channel catfish, sauger, white bass and walleye.

The commercial fish harvest was 443,500 pounds and was valued at $104,700. Buffalo species were caught in greatest numbers followed by catfish and carp.

The pool is heavily used each year by resident and migratory birds. In general, most avian use is concentrated in the central and lower portions. The birds exploit every source of food but are heavy users of terrestrial plant seeds, marsh grasses, aquatic plants and invertebrates.

Many thousands of waterfowl using the Mississippi Flyway stop briefly to rest and feed in Pool 11 during the spring and fall migrations. Of surface feeding ducks, mallard and wood ducks are most common and teal and baldpate share secondary importance. Scaup use the pool in large numbers. Approximately 6,800 ducks and geese were harvested in 1977 and 7,900 man-days were spent afield seeking waterfowl. Waterfowl hunting resulted in expenditures of over $85,400.

Upland birds in the pool include pheasant, mourning dove,1/ 2/ bobwhite quail, ruffed grouse, 2/ and turkey.2/ Approximately 2,100 upland game birds were harvested in 1977.

The pool supports numerous mammal species. Species common in the area include muskrat, squirrel, raccoon, rabbit, beaver, opossum, mink, fox, skunk, woodchuck, otter, badger, and white-tailed deer. Raccoon, muskrat, beaver, mink, opossum, otter, fox, and skunk depend heavily on the productive marsh and shoreline habitat.

Recreational hunters seeking small game 3/ harvested 35,000 animals. 4/ In addition, 1,400 hunter days were spent harvesting 60 white-tailed deer. Species harvested for their pelts included muskrat, mink, raccoon, opossum, fox, beaver, skunk, and coyote. Commercial fur harvest amounted to 19,500 pelts valued at approximately $122,000. Three thousand nine hundred man-days were spent harvesting furbearers.

Endangered and/or threatened species in Pool 11 are noted in Table 10.

A total of 17,820 acres have been set aside for wildlife protection and management in Pool 11, which represents 62 percent of the total floodplain acreage. See Table 9 for the distribution of this land.

V. B. Pool 12

Terrestrial habitat types and their acreage include: aquatic marshland (1,500 acres), herbaceous growth (700 acres), sand and mud (30 acres), forestlands (5,200 acres), agricultural lands (160 acres), dredge material (30 acres), and developed lands (700 acres).

1/ Iowa does not allow hunting for doves.
2/ Hunter use and harvest values are not available for these species.
3/ Includes rabbit, squirrel, and woodchuck.
4/ Woodchuck data not available for this pool.

TABLE 10

Federal and State Endangered and/or Threatened Species
Pool 11

	Federal	Wisconsin	Iowa
Plants	Northern Wild Monkshood (T)	*Carex media* (E)	
		Pink Milkwart (E)	
		Northern Wild Monkshood (T)	
		White Lady's Slipper (T)	
		Tubercled Orchid (T)	
Invertebrates	Higgins-eye Pearly Mussel (E)	Higgins-eye Pearly Mussel (E)	Iowa Pleistocene Snail (E)
Fish		Striped Shiner (E)	Lake Sturgeon (E)
		Crystal Darter (E)	Pallid Sturgeon (E)
		Goldeye (T)	Skipjack Herring (T)
		Speckled Chub (T)	Western Sand Darter (T)
		Pallid Shiner (T)	Grass Pickeral (T)
		Blue Sucker (T)	Mud Darter (T)
		Black Buffalo (T)	Bluntnose Darter (T)
		River Redhorse (T)	Chestnut Lamprey (T)
		Mud Darter (T)	Weed Shiner (T)
Reptiles		Ornate Box Turtle (E)	Blandings Turtle (T)
		Western Ribbon Snake (E)	Five-lined Skink (T)
		Massasauga (E)	Massasauga (T)
		Blandings Turtle (T)	Ornate Box Turtle (T)
Birds	Bald Eagle (E)	Double-crested Cormorant (E)	Upland Sandpiper (E)
	American Perigrine Falcon (E)	Bald Eagle (E)	Red-shouldered Hawk (E)
	Artic perigrine Falcon (E)	Osprey (E)	Northern Harrier (E)
		Perigrine Falcon (E)	Perigrine Falcon (E)
		Forester's Tern (E)	Cooper's Hawk (T)
		Barn Owl (E)	Long-eared Owl (T)
		Great Egret (T)	Blue-winged Warbler (T)
Mammals	Indiana Bat (E)		Bobcat (E)
			Woodland Vole (E)
			Indiana Bat (E)
			Black Bear (E)
			River Otter (T)

E-Endangered   T-Threatened

Aquatic habitat types and their acreage include: main channel (1,400 acres), main channel border (3,300 acres), side channel (400 acres), sloughs-side streams, river lakes and ponds, and submergent and floating vegetation (5,600 total acres). Levee bound backwaters are included under sloughs and streams.

Although no formal studies of aquatic insects and other invertebrates have been conducted in this pool, the presence of species of fish indicates the presence of certain aquatic invertebrates. For example, bigmouth and smallmouth buffalo are present in harvestable quantities. This indicates the presence of Cladocera and Copepoda on which these species feed. The pool is considered to have a species rich and populous mussel fauna. Mussel records reveal the presence of 26 species in this pool. Commercial harvest of mussels is negligible.

There have been 68 species of fish recorded in this pool. Of these, 34 are considered common. Fish utilize every available portion of the pool. However, it is the off-channel areas which provide the essential spawning, rearing, resting and feeding habitat for the majority of species.

Sportfishing provided 389,000 activity days or 37 percent of the total recreational activity. This activity contributed approximately $3.5 million (1975 dollars) to the economy. Species most actively sought by fishermen were crappie, bluegill, freshwater drum, channel catfish, sauger, white bass and walleye. The commercial fish harvest was 248,300 pounds and was valued at $70,400. Buffalo species were caught in greatest numbers followed by catfish and carp.

Pool 12 is heavily used each year by many species of birds. The cultivated fields, pastures, wooded stream courses, forested islands, shore areas, and sandy beaches found along most of the length of Pool 12 provide excellent habitats for birds with widely varying food, nesting and protective cover needs. It is common to find marsh and grass-loving birds in shallow slough and backwater areas within islands and along shoreline areas, and migratory waterfowl which graze in deeper waters in the open channels of the Mississippi River. Predatory marsh and shorebirds, such as the great blue heron, find most of their prey in shallow marsh areas and along beaches; such other hunting birds as the great horned owl, hawk and bald eagle are less limited in range of habitat. The many fields and roadsides of the flat country surrounding Pool 12 provide an abundance of seeds and insects ideal for songbirds, which are common in such areas.

Thousands of waterfowl using the Mississippi Flyway stop briefly to rest and feed in Pool 12 during the spring and fall migrations. Of surface feeding ducks, mallard is most common and teal, wood duck, and baldpate share secondary importance. Scaup use the pool

in moderate numbers. Approximately 5,400 ducks and geese were harvested in 1977 and 11,100 man-days were spent afield seeking waterfowl. Over $120,000 (1975 dollars) were spent in pursuit of waterfowl in this pool.

Two major nesting rookeries for the great blue heron are located in Pool 12. Common egrets and black-crowned night herons also nest at the heron rookeries.

Marginal habitat conditions and frequent spring flooding normally discourage use of the Pool 12 bottomlands by upland game birds.

Upland birds in the pool include pheasant, mourning dove,1/ and bobwhite quail. Approximately 10,000 hunter-days were spent afield harvesting 16,000 upland game birds in 1977. This results in expenditures of more than $63,000 (1975 dollars).

The pool supports numerous mammal species. Species common in the area include: muskrat, raccoon, beaver, opossum, fox, skunk, otter, and white-tailed deer. Raccoon, muskrat, beaver, mink, and otter depend heavily on the productive marsh and shoreline habitat.

Recreational hunters seeking small game2/ spent 11,000 days afield, representing $69,000 in expenditures (1975 dollars) and a harvest of 23,000 animals. 3/ In addition, 1,600 hunter days, representing $32,000 in expenditures (1975 dollars), were spent harvesting 200 white-tailed deer. Species harvested for their pelts included muskrat, mink, raccoon, opossum, fox, beaver, skunk, and coyote. Commercial fur harvest amounted to 8,300 pelts valued at approximately $136,000. Approximately 7,000 man-days, representing $24,000 in expenditures (1975 dollars), were spent harvesting furbearers.

Endangered and/or threatened species in Pool 12 are noted in Table 11.

A total of 9,225 acres have been set aside for wildlife protection and management in Pool 12, which represents 48 percent of the total floodplain acreage. See Table 9 for the distribution of this land.

V. C. Pool 13

Terrestrial habitat types and their acreage include: aquatic marshland (700 acres), herbaceous growth (1,200 acres), forestlands (9,400 acres), agricultural lands (2,500 acres), sand and

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1/ Iowa does not allow hunting for doves.
2/ Includes rabbit, squirrel, and woodchuck.
3/ Woodchuck data not available for this pool.

TABLE II

Federal and State Endangered and/or Threatened Species
Pool 12

	Federal	Wisconsin	Iowa	Illinois
Plants	Northern Wild Monkshood (T)	Northern Wild Monkshood (T) White Lady's Slipper (T) Tubercled Orchid (T) Pink Milkwort (E) Hairy Meadow Parsnip (E)		
Invertebrates	Higgins' Eye Pearly Mussel (E)	Higgins' Eye Pearly Mussel (E)		
Fish		Goldeye (T) Speckled Chub (T) Black Buffalo (T)	Western Sand Darter (T) Weed Shiner (T)	
Amphibians Reptiles		Pickerel Frog (T) Blanding's Turtle (T) Ornate Box Turtle (E) Massasauga (E) Western Ribbon Snake (E)	Central Newt (E) Five-lined Skink (T) Blanding's Turtle (T) Stinkpot (T) Ornate Box Turtle (T) Black Rat Snake (T) Massasauga (T)	
Birds	Artic & American Peregrine Falcon (E) Bald Eagle (E)	Cooper's Hawk (T) Red-shouldered Hawk (T) Peregrine Falcon (E) Bald Eagle (E) Osprey (E) Great Egret (T) Double-crested Cormorant (E) Forster's Tern (E)	Cooper's Hawk (T) Red-shouldered Hawk (E) Marsh Hawk (E) Peregrine Falcon (E) Broad-winged Hawk (T) Long-eared Owl (T) Upland Sandpiper (E) Blue-winged Warbler (T)	Cooper's Hawk (E) Red-shouldered Hawk (E) Swainson's Hawk (E) Marsh Hawk (E) Peregrine Falcon (E) Bald Eagle (E) Osprey (E) Barn Owl (E) Long-eared Owl (E) Short-eared Owl (E) Wilson's Phalarope (E) Common Gallinule (T) Yellow Rail (E) Black-crowned Night Heron (E) Great Egret (E) Double-crested Cormorant (E) Upland Sandpiper (E) Forster's Tern (E) Yellow-headed Blackbird (E) Veery (T) Brown Creeper (E)
Mammals	Indiana Bat (E)		Indiana Bat (E) Keen's Myotis (T) Black Bear (E) Bobcat (E) River Otter (T) Woodland Vole (E)	Indiana Bat (E) Bobcat (T) River Otter (T) Woodland Vole (E)

E - Endangered T - Threatened

mud (200 acres), dredge material (100 acres), and developed lands (600 acres).

Aquatic habitat types and their acreage include: main channel (1,900 acres), main channel border (8,300 acres), sloughs-side streams, river lakes and ponds and submergent and floating vegetation (13,400 total acres). Levee bound backwaters are included under sloughs and streams.

Caddisflies and mayflies are reported as the most common aquatic insects and invertebrates that have been observed in Pool 13. The FWMWG wing-dam study confirms this observation. The pool is considered to have a species rich and populous mussel population. Mussel records reveal the presence of 24 species in this pool. Commercial harvest of mussels is negligible.

There have been 70 species of fish recorded in this pool. Of these 34 are considered common. Fish utilize every available portion of the pool. However, it is the off-channel areas which provide the essential spawning, rearing, resting and feeding habitat for the majority of species.

Sportfishing provided 384,000 activity days or 38 percent of the total recreational activity. This activity contributed approximately $3.5 million (1975 dollars) to the economy. Species most actively sought by fishermen were crappie, blue gill, channel catfish, white bass, and bullhead.

The commercial fish harvest was 932,900 pounds and was valued at $212,000. Buffalo species were caught in greatest numbers followed by carp and catfish.

The variety of cultivated fields, pastures, wooded stream courses, forested island, shore areas, and sandy beaches found along most of the length of Pool 13 provides excellent habitat for birds widely varying food, nesting and protective cover needs. Marsh and shorebirds are most likely to be found in the broad marshy areas of the northern and central portions of the pool. Sharing that habitat are the marsh-oriented migratory waterfowl; the diving ducks feed on invertebrates and the roots and bulbs of submerged aquatic plants in the deeper, open water areas most common in the lower portion of the pool.

Several thousand waterfowl using the Mississippi Flyway stop briefly to rest and feed in Pool 13 during the spring and fall migrations. Of surface feeding ducks, mallard is most common and teal, wood duck, and baldpate share secondary importance. Scaup use the pool in moderate numbers. Approximately 13,200 ducks and geese were harvested in 1977 and 21,200 man-days, representing $229,700 in expenditures (1975 dollars), were spent afield seeking waterfowl.

Great blue herons, common egrets and black-crowned night herons are some of the marsh birds which pass through Pool 13 during their annual migrations.

Upland birds in the pool include pheasant, mourning dove, [1/] and bobwhite quail. Approximately 15,000 hunter-days, representing $94,000 in expenditures (1975 dollars), were spent afield harvesting 28,000 upland game birds in 1977.

The pool supports numerous mammal species. Species common in the area include: muskrat, raccoon, rabbit, beaver, opossum, woodchuck, badger, and white-tailed deer.

Although extensive areas of low island and shore in the central and upper reaches of Pool 13 provide suitable habitat for deer, large quantities of habitat favored by these animals are available in wooded valleys and ridges flanking the pool, especially on the Illinois shore.

Recreational hunters seeking small game[2/] spent 16,000 days afield, representing $101,000 in expenditures (1975 dollars), and a harvest of 34,000 animals.[3/] In addition, 1,800 ($37,000 in expenditures in 1975 dollars) hunter-days were spent harvesting 250 white-tailed deer. Species harvested for their pelts included muskrat, mink, raccoon, opossum, fox, beaver, skunk, and coyote. Commercial fur harvest amounted tc 11,300 pelts valued at approximately $182,000. Approximately 10,000 man-days, representing $34,000 in expenditures (1975 dollars), were spent harvesting furbearers.

Endangered and/or threatened species in Pool 13 are noted in Table 12.

A total of 32,948 acres have been set aside for wildlife management and protection in Pool 13, which represents 78 percent of the total floodplain acreage. See Table 9 for the distribution of this land.

V. D. Pool 14

Terrestrial habitat types and their acreage include: aquatic marshland (500 acres), herbaceous growth (800 acres), forestlands (7,000 acres), agricultural lands (1,100 acres), sand and mud (50 acres), dredge material (70 acres), and developed lands (1,500 acres).

1/ Iowa does not allow dove hunting.
2/ Includes rabbit, squirrel, and woodchuck.
3/ Woodchuck data not available for this pool.

TABLE 12

Federal and State Endangered and/or Threatened Species
Pool 13

	Federal	Iowa	Illinois
Plants	Northern Wild Monkshood (T)		
Invertebrates	Higgins' Eye Pearly Mussel (E)		
Fish		Western Sand Darter (T)	
		Mud Darter (T)	
		Skipjack Herring (T)	
Amphibians		Central Newt (E)	
Reptiles		Western Slender Glass Lizard (E)	Western Hognose Snake (T)
		Blanding's Turtle (T)	
		Stinkpot (T)	
		Ornate Box Turtle (T)	
		Black Rat Snake (T)	
		Graham's Water Snake (T)	
		Massasauga (T)	
Birds	Arctic Peregrine Falcon (E)	Cooper's Hawk (T)	Cooper's Hawk (E)
	American Peregrine Falcon (E)	Red-shouldered Hawk (E)	Red-shouldered Hawk (E)
	Bald Eagle (E)	Marsh Hawk (E)	Swainson's Hawk (E)
		Peregrine Falcon (E)	Marsh Hawk (E)
		Broad-winged Hawk (T)	Peregrine Falcon (E)
		Long-eared Owl (T)	Bald Eagle (E)
		Upland Sandpiper (E)	Osprey (E)
		Blue-winged Warbler (T)	Barn Owl (E)
			Long-eared Owl (E)
			Short-eared Owl (E)
			Wilson's Phalarope (E)
			Common Gallinule (T)
			Yellow Rail (E)
			Black Rail (E)
			Black-crowned Night Hernon (E)
			Great Egret (E)
			Double-crested Cormorant (E)
			Upland Sandpiper (E)
			Forster's Tern (E)
			Yellow-headed Blackbird (E)
			Veery (T)
			Brown Creeper (E)
Mammals	Indiana Bat (E)	Indiana Bat (E)	Indiana Bat (E)
		Keen's Myotis (T)	River Otter (T)
		River Otter (T)	White-tailed Jackrabbit (E)
		Woodland Vole (E)	

E-Endangered T-Threatened

Aquatic habitat types and their acreage include: main channel (1,600 acres), main channel border (4,800 acres), side channel (400 acres), sloughs-side streams, river lakes and ponds, and submergent and floating vegetation (2,900 total acres). Levee bound backwaters are included under sloughs and streams.

Studies were performed during 1972 of Pool 14 on such aquatic invertebrates as insects. During five sampling days from March through early July, 33 families were found, represented by 40-53 genera. The Chrionomidae (midges) consistently contributed the major portion of genera and represented 28 to 50 percent of the total genera identified in the samples. Between late March and early July, 1972, 200 zooplankton samples were collected. Samples contained Crustacea, ladocera, Amphipoda and some ostracod species. Copepoda were also collected in very high amounts. The pool is considered to have a species rich and populous mussel population. Mussel records reveal the presence of 27 species in this pool. Commercial harvest of mussels amounted to approximately 82,000 pounds and its estimated value is $5,700.

There have been 66 species of fish recorded in this pool. Of these 35 are considered common. Fish utilize every available portion of the pool. However, it is the off-channel areas which provide the essential spawning, rearing, resting and feeding habitat for the majority of species.

Sportfishing provided 480,000 activity days or 37 percent of the total recreational activity. This activity contributed approximately $4.3 million (1975 dollars) to the economy. Species most actively sought by fishermen were crappie, bluegill, freshwater drum, channel catfish, white bass, and bullhead.

The commercial fish harvest was 285,300 pounds and was valued at $61,000 dollars. Carp were caught in greatest numbers followed by buffalo and catfish.

The variety of cultivated fields, pastures, wooded stream courses, forested island and shore areas, and sandy beaches along most of Pool 14 provides excellent habitat for birds or widely varying food, nesting and protective cover needs. Marsh and shore birds are most likely to be found in the northern and central portions of the pool where low islands and quiet backwaters support a profusion of aquatic vegetation. Sharing that habitat are the marsh-loving waterfowl species: ducks and other birds that dive for their food in deeper waters are most often observed in the lower, more open reaches of Pool 14. Fields, roadsides and edges of small urban areas provide ideal habitat for many insect-eating and seed-eating songbirds.

Several thousand waterfowl using the Mississippi Flyway stop briefly to rest and feed in Pool 14 during the spring and fall migrations. Of surface feeding ducks, mallard is most common and teal, wood duck, and baldpate share secondary importance. Scaup use the pool in minor numbers. Canvasback and ringneck are of secondary importance. Approximately 8,700 ducks and geese were harvested in 1977 and 19,900 man-days, representing $215,800 in expenditures (1975 dollars), were spent afield seeking waterfowl.

A heron rookery is located just north of Fulton, Illinois, at river mile 521.5. Common egrets and black-crowned night herons are other marsh birds that may often nest with great blue herons.

Upland birds in the pool include pheasant, mourning dove1/, and bobwhite quail. Approximately 16,000 hunter-days were spent afield harvesting 25,000 upland game birds in 1977. This resulted in an expenditure of $101,000 (1975 dollars) in the pool.

The pool supports numerous mammal species. Species common in the area include: muskrat, squirrel, raccoon, rabbit, beaver, mink, fox, skunk, and white-tailed deer. The broad, low-lying and heavily forested delta of the Wapsipinicon River harbors the greatest concentration of white-tailed deer, although the deer range freely over most of the adjacent ridges, wooded areas and farmlands.

Recreational hunters seeking small game2/ spent 20,000 days afield representing $126,000 (1975 dollars) and a harvest of 41,000 animals.3/ In addition, 400 hunter days were spent harvesting 160 white-tailed deer and adding $8,000 to the economy. Species harvested for their pelts included muskrat, mink, raccoon, opossum, fox, beaver, skunk, and coyote. Commercial fur harvest amounted to 8,400 pelts valued at approximately $132,000. Approximately 12,000 man-days, representing $40,000 (1975 dollars) in expenditures, were spent harvesting furbearers.

Endangered and/or threatened species in Pool 14 are noted in Table 13.

A total of 7,542 acres have been set aside for wildlife management and protection in Pool 14 which represents 36 percent of the total floodplain acreage. See Table 9 for a breakdown of the distribution of this land among resource agencies.

1/ Iowa does not allow dove hunting.
2/ Includes rabbit, squirrel, and woodchuck.
3/ Woodchuck data not available for this pool.

TABLE 13

Federal and State Endangered and/or Threatened Species
Pool 14

	Federal	Iowa	Illinois
Invertebrates	Higgins Eye Pearly Mussel (E)		
Fish		Western Sand Darter (T)	
		Grass Pickerel (T)	
Reptiles		Western Slender Glass Lizard (E)	Illinois Mud Turtle (E)
		Illinois Mud Turtle (E)	Western Hognose Snake (T)
		Blanding's Turtle (T)	
		Stinkpot (T)	
		Ornate Box Turtle (T)	
		Black Rat Snake (T)	
		Graham's Water Snake (T)	
		Massasauga (T)	
Birds	Artic Peregrine Falcon (E)	Cooper's Hawk (T)	Cooper's Hawk (E)
	American Peregrine Falcon (E)	Red-shouldered Hawk (E)	Red-shouldered Hawk (E)
	Bald Eagle (E)	Marsh Hawk (E)	Marsh Hawk (E)
		Peregrine Falcon (E)	Peregrine Falcon (E)
		Broad-winged Hawk (T)	Bald Eagle (E)
		Long-eared Owl (T)	Osprey (E)
		Upland Sandpiper (E)	Barn Owl (E)
		Blue-winged Warbler (T)	Long-eared Owl (E)
			Short-eared Owl (E)
			Common Gadinule (T)
			Yellow Rail (E)
			Black Rail (E)
			Black-crowned Night Heron (E)
			Great Egret (E)
			Double-crested Cormorant (E)
			Upland Sandpiper (E)
			Forster's Tern (E)
			Yellow-headed Blackbird (E)
			Veery (T)
			Brown Creeper (E)
Mammals	Indiana Bat (E)	Indiana Bat (E)	Indiana Bat (E)
		Keen's Myotis (T)	River Otter (T)
		River Otter (T)	White-tailed Jackrabbit (E)
		Woodland Vole (E)	

E - Endangered T-Threatened

V. E. Pool 15

Terrestrial habitat types and their acreage include: aquatic marshland (20 acres), herbaceous growth (200 acres), forestlands (300 acres), agricultural lands (400 acres), sand and mud (20 acres), dredge material (1 acre), and developed lands (1,800 acres).

Aquatic habitat types and their acreage include: main channel (500 acres); main channel border (2,100 acres); side channel (400 acres); sloughs-side streams, river lakes and ponds, and submergent and floating vegetation (500 total acres). Levee bound backwaters are included under sloughs and streams.

Information on aquatic invertebrates other than mussels is lacking. It is safe to assume populations of damselflies and caddisflies occur in relatively high abundance in the pool. Mussel populations are fairly diversified and locally abundant. Mussel records reveal the presence of 29 species in this pool. Commercial harvest of mussels is approximately 32,000 pounds and its estimated value is $2,200.

There have been 64 species of fish recorded in this pool. Of these, 34 are considered common. Sportfishing provided 274,000 activity days or 26 percent of the total recreational activity. This activity contributed approximately $2.5 million (1975 dollars) to the economy. Species most actively sought by fishermen were freshwater drum, channel catfish, sauger, white bass, and walleye.

The commercial fish harvest was 87,000 pounds and was valued at $22,900. Buffalo species were caught in greatest numbers followed by carp and catfish.

The extensive urbanization surrounding this pool severely restricts its value as bird habitat. Waterfowl use is primarily restricted to resting areas. Upland game use is minor and restricted to areas along the upper end of the pool and Arsenal Island. Upland game and waterfowl hunting is not allowed within the pool area.

Pool 15 environs supports minimal populations of muskrat, raccoon, fox and groundhogs. Hunting for small game and deer is not allowed in the pool area. Furharvest amounted to 340 pelts valued at approximately $3,400. Approximately 2,200 man-days, representing $7,000 (1975 dollars) in expenditures, were spent harvesting furbearers.

Endangered and/or threatened species in Pool 15 are noted in Table 14.

Pool 15 has no land set aside for wildlife management or protection.

TABLE 14

Federal and State Endangered and/or Threatened Species
Pool 15

	Federal	Iowa	Illinois
Invertebrates	Higgins' Eye Pearly Mussel (E)		
Fish		Western Sand Darter (T) Skipjack Herring (T)	
Reptiles		Western Slender Glass Lizard (E) Illinois Mud Turtle (E) Blanding's Turtle (T) Red-eared Turtle (T) Stinkpot (T) Ornate Box Turtle (T) Black Rat Snake (T) Graham's Water Snake (T) Massasauga (T)	Illinois Mud Turtle (E)
Birds	Artic Peregrine Falcon (E) American Peregrine Falcon (E) Bald Eagle (E)	Cooper's Hawk (T) Red-shouldered Hawk (E) Marsh Hawk (E) Broad-winged Hawk (T) Peregrine Falcon (E) Long-eared Owl (T) Upland Sandpiper (E)	Cooper's Hawk (E) Red-shouldered Hawk (E) Marsh Hawk (E) Bald Eagle (E) Peregrine Falcon (E) Osprey (E) Barn Owl (E) Long-eared Owl (E) Short-eared Owl (E) Common Gallinole (T) Yellow Rail (E) Black Rail (E) Black-crowned Night Heron (E) Great Egret (E) Double-crested Cormorant (E) Upland Sandpiper (E) Forster's Tern (E) Yellow-headed Blackbird (E) Veery (T) Brown Creeper (E)
Mammals	Indiana Bat (E)	Indiana Bat (E) Keen's Myotis (T) Evening Bat (T) River Otter (T) Woodland Vole (E)	Indiana Bat (E) River Otter (T) White-tailed Jackrabbit (E)

E - Endangered T - Threatened

V. F. Pool 16

Terrestrial habitat types and their acreage include: aquatic marshland (800 acres), herbaceous growth (800 acres), forestlands (5,500 acres), agricultural lands (1,700 acres), sand and mud (30 acres), dredge material (50 acres), and developed lands (1,500 acres).

Aquatic habitat types and their acreage include: main channel (1,400 acres); main channel border (4,400 acres); side channel (1,100 acres); sloughs-side streams, river lakes and ponds, and submergent and floating vegetation (3,800 total acres). Levee bound backwaters are included under sloughs and streams.

The presence of plankton-eating fish, such as bigmouth and small-mouth buffalo, river carpsucker, paddlefish, and gizzard shad in Pool 16 indicates population of Copepoda and Cladocera large enough to support these species. The pool is considered to have species rich and populous mussel populations. Mussel records reveal the presence of 31 species in this pool. Commercial harvest of mussels is approximately 75,000 pounds and its estimated value is $5,200.

There have been 71 species of fish recorded in this pool. Of these 34 are are considered common. Fish utilize every available portion of the pool. However, it is the off channel areas which provide the essential spawning, rearing, resting and feeding habitat for the majority of species.

Sportfishing provided 562,000 activity days or 37 percent of the total recreational activity. This activity contributed approximately $5.0 million (1975 dollars) to the economy. Species most actively sought by fishermen were crappie, bluegill, channel catfish, sauger, white bass, and walleye.

The commercial fish harvest was 316,800 pounds and was valued at $57,100. Carp were caught in greatest numbers followed by buffalo and catfish.

Pool 16 is moderately used each year by many species of birds. The area contains a wide variety of habitats, including residential and business areas on the shores of the northern portion of the pool and cultivated fields, pastures, wooded stream courses, and forested island and shore areas along the rest of the pool boundary.

Several thousand waterfowl using the Mississippi Flyway stop briefly to rest and feed in Pool 16 during the spring and fall

migrations. Of surface feeding ducks, mallard is most common with teal and baldpate sharing secondary importance.

Approximately 9,600 ducks and geese were harvested in 1977 and 15,900 man-days were spent afield seeking waterfowl. Over $171,900 (1975 dollars) were spent in pursuit of waterfowl in this pool.

Marginal habitat conditions and frequent spring flooding probably exclude most upland game birds from the bottomlands surrounding the pool although a small number may inhabit the nearby farmlands and wooded hillsides. Upland birds in the pool include pheasant, mourning dove,1/ and bobwhite quail. Approximately 4,000 hunter-days were spent afield harvesting 25,400 upland game birds in 1977. This represents $25,000 (1975 dollars) in expenditures in this pool.

The pool supports numerous mammal species. Species common in the area include: muskrat, raccoon, rabbit, beaver, opossum, skunk, and white-tailed deer. White-tailed deer range over the natural areas of the Pool 16 valley, finding most of their preferred food and shelter conditions in the forested bluffs and valleys along the Illinois shore. Andalusia Island is also utilized by deer.

Recreational hunters seeking small game2/ spent 8,000 days afield, representing $50,000 (1975 dollars) in expenditures, and a harvest of 29,000 animals.3/ In addition, 1,600 hunter-days were spent harvesting 150 white-tailed deer. Deer hunting resulted in expenditures of $32,000 (1975 dollars) in this pool. Species harvested for their pelts included muskrat, mink, raccoon, opossum, fox, beaver, skunk, and coyote. Commercial fur harvest amounted to 4,100 pelts valued at approximately $74,000. Approximately 4,300 man-days, representing $14,000 (1975 dollars) in expenditures, were spent harvesting furbearers.

Endangered and/or threatened species in Pool 16 are noted in Table 15.

A total of 6,640 acres have been set aside for wildlife protection and management in Pool 16, which accounts for 31 percent of the floodplain acreage. See Table 9 for distribution of these lands among resource agencies.

1/ Iowa does not allow dove hunting.
2/ Includes rabbit, squirrel, and woodchuck.
3/ Woodchuck data is not available for this pool.

TABLE 15

Federal and State Endangered and/or Threatened Species
Pool 16

	Federal	Iowa	Illinois
Invertebrates	Higgin's Eye Pearly Mussel (E)		
Fish		Sand Darter (T) Lake Sturgeon (E) Skipjack Herring (T)	Lake Sturgeon (T)
Reptiles		Five-lined Skink (T) Western Slender Glass Lizard (E) Illinois Mud Turtle (E) Blanding's Turtle (T) Red-eared (T) Stinkpot (T) Ornate Box Turtle (T) Black Rat Snake (T) Yellow-bellied Water Snake (T) Graham's Water Snake (T) Massasauga (T)	Illinois Mud Turtle (E)
Birds	American Peregrine Falcon (E) Artic Peregrine Falcon (E) Bald Eagle (E)	Cooper's Hawk (T) Red-shouldered Hawk (E) Marsh Hawk (E) Peregrine Falcon (E) Broad-winged Hawk (T) Long-eared Owl (T) Upland Sandpiper (E) Blue-winged Warbler (T)	Cooper's Hawk (E) Red-shouldered (E) Marsh Hawk (E) Peregrine Falcon (E) Bald Eagle (E) Osprey (E) Long-eared Owl (E) Short-eared Owl (E) Common Gallinule (T) Yellow Rail (E) Black Rail (E) Black-crowned Night Heron (E) Great Egret (E) Double-crested Cormorant (E) Upland Sandpiper (E) Forster's Tern (E) Veery (T) Brown Creeper (E)
Mammals	Indiana Bat (E)	Indiana Bat (E) Keen's Myotis (T) Evening Bat (T) River Otter (T) Woodland Vole (E)	Indiana Bat (E) River Otter (T)

E - Endangered   T - Threatened

V. G. Pool 17

Terrestrial habitat types and their acreage include: aquatic marshland (300 acres), herbaceous growth (900 acres), forest-lands (7,400 acres), agricultural lands (400 acres, sand and mud (300 acres), dredge material (100 acres), and developed lands (600 acres).

Aquatic habitat types and their acreage include: main channel (1,100 acres); main channel border (2,800 acres); side channel (400 acres); sloughs-side streams, river lakes and ponds, and submergent and floating vegetation (3,500 total acres). Levee bound backwaters are included under sloughs and streams.

Although no surveys of invertebrates have been done in Pool 17, the presence of plankton-eating fish (i.e. bigmouth and small-mouth buffalo, river carpsucker, and gizzard shad) indicates populations of planktonic Copepoda and Cladocera large enough to support these fish species. The pool is considered to have a species rich and populous mussel fauna. Mussel records reveal the presence of 28 species in this pool. Commercial harvest of mussels is approximately 94,000 pounds and its estimated value is $6,600.

There have been 66 species of fish recorded in this pool. Of these, 34 are considered common. Fish utilize every available portion of the pool. However, it is the off-channel areas which provide the essential spawning, rearing, resting, and feeding habitat for the majority of species.

Sportfishing provided 308,000 activity days or 40 percent of the total recreational activity. This activity contributed approximately $2.8 million (1975 dollars) to the economy. Species most actively sought by fishermen were crappie, bluegill, channel catfish, and largemouth bass.

The commercial fish harvest was 441,500 pounds and was valued at $82,400. Carp were caught in greatest numbers followed by buffalo species and catfish.

In combination with the large areas along both sides of the river that are under cultivation, the residential fringes of Muscatine attract and support a large population of songbirds. The extensive marsh and slough areas that characterize the low island and shoreline areas of the rest of the pool provide abundantly for the needs of marsh and shorebirds, as well as for large, transient populations of migratory waterfowl. Areas of particular importance for the birds are found on Bogus, Turkey, and other islands; and the open areas within the Louisa Refuge provide nesting and roosting places for crows and large birds of prey, such as hawks, owls, and eagles.

Thousands of waterfowl using the Mississippi Flyway stop briefly to rest and feed in Pool 17 during the spring and fall migrations. Of surface feeding ducks, mallard is most common and teal, wood duck, and baldpate share secondary importance. Scaup use the pool in large numbers. Approximately 14,800 ducks and geese were harvested in 1977 and 23,600 man-days were spent afield seeking waterfowl. Over $255,700 (1975 dollars) were spent in pursuit of waterfowl.

Upland birds in the pool include pheasant, mourning dove [1/] and bobwhite quail. Approximately 5,000 hunter-days were spent afield harvesting 28,000 upland game birds in 1977. Upland game expenditures are over $176,000 (1975 dollars) annually in this pool.

The pool supports numerous mammal species. Species common in the area include: muskrat, squirrel, rabbit, fox, skunk, woodchuck, and white-tailed deer.

Recreational hunters seeking small game[2/] spent 10,300 days afield, representing $65,000 (1975 dollars) in expenditures, and a harvest of 27,000 animals.[3/] In addition, 1,200 hunter-days were spent harvesting 150 white-tailed deer. Over $24,000 (1975 dollars) were spent by deer hunters annually in this pool. Species harvested for their pelts included muskrat, mink, raccoon, opossum, fox, beaver, skunk, and coyote. Commercial fur harvest amounted to 6,800 pelts valued at approximately $112,000. Approximately 5,400 man-days, representing $18,000 (1975 dollars) in annual expenditures, were spent harvesting furbearers.

Endangered and/or threatened species in Pool 17 are noted in Table 16.

A total of 8,640 acres have been set aside for wildlife management and protection in Pool 17, which accounts for 49 percent of the floodplain acreage. Table 9 presents a breakdown of these lands among resource agencies.

V. H. Pool 18

Terrestrial habitat types and their acreage include: aquatic marshland (700 acres), herbaceous growth (500 acres, forestlands (7,700 acres), agricultural lands (400 acres), sand and mud (200 acres), dredge material (100 acres), and developed lands (100 acres).

1/ Iowa does not allow dove hunting.
2/ Includes rabbit, squirrel, and woodchuck.
3/ Woodchuck data not available for this pool.

TABLE 16

Federal and State Endangered and/or Threatened Species
Pool 17

	Federal	Iowa	Illinois
Invertebrates	Higgins' Eye Pearly Mussel (E)		
Fish		Western Sand Darter (T)	Lake Sturgeon (T)
		Grass Pickerel (T)	
		Lake Sturgeon (E)	
		Skipjack Herring (T)	
Reptiles		Five-lined Skink (T)	Illinois Mud Turtle (E)
		Western Slender Glass Lizard (E)	
		Illinois Mud Turtle (E)	
		Blanding's Turtle (T)	
		Red-eared Turtle (T)	
		Stinkpot (T)	
		Ornate Box Turtle (T)	
		Black Rat Snake (T)	
		Yellow-bellied Water Snake (T)	
		Graham's Water Snake (T)	
		Diamondback Water Snake (T)	
		Massasauga (T)	
Birds	Arctic Peregrine Falcon (E)	Cooper's Hawk (T)	Cooper's Hawk (E)
	American Peregrine Falcon (E)	Red-shouldered Hawk (E)	Red-shouldered Hawk (E)
	Bald Eagle	Marsh Hawk (E)	Marsh Hawk (E)
		Peregrine Falcon (E)	Peregrine Falcon (E)
		Broad-winged Hawk (T)	Bald Eagle (E)
		Long-eared Owl (T)	Osprey (E)
		Upland Sandpiper (E)	Long-eared Owl (E)
		Blue-winged Warbler (T)	Short-eared Owl (E)
			Common Gallinule (T)
			Yellow Rail (E)
			Black Rail (E)
			Black Crowned Night Heron (E)
			Great Egret (E)
			Double-crested Cormorant (E)
			Upland Sandpiper (E)
			Forster's Tern (E)
			Veery (T)
			Brown Creeper (E)
Mammals	Indiana Bat (E)	Indiana Bat (E)	Indiana Bat (E)
		Keen's Myotis (T)	River Otter (T)
		Evening Bat (T)	
		River Otter (T)	
		Woodland Vole (E)	

E-Endangered T-Threatened

Aquatic habitat types and their acreage include: main channel (1,400 acres); main channel border (5,200 acres); side channel (0 acres); sloughs-side streams, river lakes and ponds, and submergent and floating vegetation (4,100 total acres). Levee bound backwaters are included under sloughs and streams.

The presence of buffalo fish and other species in Pool 18 indicates populations of Copepoda and Cladocera large enough to support these commercially important species. Other zooplankton, collected in mid-channel between wing dams and a slough, include the rotifer genera *Keratella*, *Synchaeta*, and *Notholca*. Benthic species collected include mayflies, caddisfly larvae, and proboscis worms. The pool is considered to have species rich and locally abundant mussel populations. Mussel records reveal the presence of 22 species in this pool. Commercial harvest of mussels is approximately 8,000 pounds and its estimated value is $600.

There have been 69 species of fish recorded in this pool. Of these, 34 are considered common. Fish utilize every available portion of the pool. However, it is the off-channel areas which provide the essential spawning, rearing, resting and feeding habitat for the majority of species.

Sportfishing provided 428,000 activity days or 38 percent of the total recreational activity. This activity contributed approximately $3.9 million (1975 dollars) to the economy. Species most actively sought by fishermen were crappie, bluegill, channel catfish, sauger, and walleye.

The commercial fish harvest was 665,800 pounds and was valued at $159,300. Carp were caught in greatest numbers followed by buffalo and catfish.

Pool 18 is heavily used each year by many species of birds. Some are year-round residents, others are summer residents, and many others use the resources of the pool as they pass through on their regular journeys to and from northern breeding grounds. For most of its length, Pool 18 is bordered by a low island and shore habitat, interwoven with the shallow water sloughs and marshes required by many marsh birds and migratory waterfowl. Close to the river are extensive areas of intensive agriculture that support substantial populations of songbirds and provide an additional food source for migrating geese and ducks during spring and fall. Farms also line the lower stretches of the pool where low island and marsh habitats are much less common.

Several thousand waterfowl using the Mississippi Flyway stop briefly to rest and feed in Pool 18 during the spring and fall

migrations. Of surface feeding ducks, mallard are most common. Scaup and golden-eye use the pool in moderate numbers. Approximately 10,500 ducks and geese were harvested in 1977 and 21,000 man-days were spent afield seeking waterfowl. Over $226,800 (1975 dollars) were spent in pursuit of waterfowl in this pool.

Upland birds in the pool include: pheasant, mourning dove1/ and bobwhite quail. Approximately 8,000 hunter-days were spent afield harvesting 17,000 upland game birds in 1977. This resulted in an expenditure of $50,000 (1975 dollars) in this pool.

The pool supports numerous mammal species. Species common in the area include: muskrat, squirrel, raccoon, rabbit, beaver, opossum, mink, woodchuck, and white-tailed deer. Raccoon, muskrat, beaver, mink and opossum depend heavily on the productive marsh and shoreline habitat.

Recreational hunters seeking small game2/ spent 18,000 days afield, representing $113,000 (1975 dollars) in expenditures, and a harvest of 25,000 animals.3/ In addition, 2,400 hunter-days were spent harvesting 450 white-tailed deer. Deer hunters spend over $49,000 (1975 dollars) annually in this pool. Species harvested for their pelts included muskrat, mink, raccoon, opossum, fox, beaver, skunk, and coyote. Commercial fur harvest amounted to 9,100 pelts valued at approximately $39,000. Approximately 9,800 man-days, representing $33,000 (1975 dollars) in expenditures, were spent harvesting furbearers.

Endangered and/or threatened species in Pool 18 are noted in Table 17.

A total of 8,905 acres have been set aside for wildlife protection and management in Pool 18, which represents 43 percent of the floodplain acreage. See Table 9 for the distribution of this land among various resource agencies.

V. I. Pool 19

Terrestrial habitat types and their acreage include: aquatic marshland (2,000 acres), herbaceous growth (1,300 acres), forestlands (12,300 acres), agricultural lands (19,000 acres), sand and mud (300 acres), dredge material (35 acres), and developed lands (1,900 acres).

1/ Iowa does not allow dove hunting.
2/ Includes squirrel, rabbit, and woodchuck.
3/ Woodchuck data not available for this pool.

TABLE 17

Federal and State Endangered and/or Threatened Species
Pool 18

	Federal	Iowa	Illinois
Invertebrates	Higgins' Eye Pearly Mussel (E)		
Fish		Western Sand Darter (T)	
		Grass Pickerel (T)	
		Skipjack Herring (T)	
Reptiles		Five-lined Skink (T)	Illinois Mud Turtle (E)
		Western Slender Glass Lizard (E)	
		Illinois Mud Turtle (E)	
		Blanding's Turtle (T)	
		Red-eared Mud Turtle (T)	
		Stinkpot (T)	
		Ornate Box Turtle (T)	
		Black Rat Snake (T)	
		Yellow-bellied Water Snake (T)	
		Graham's Water Snake (T)	
		Diamondback Water Snake (T)	
		Massasauga (T)	
Birds	Arctic Peregrine Falcon (E)	Cooper's Hawk (T)	Cooper's Hawk (E)
	American Peregrine Falcon (E)	Red-shouldered Hawk (E)	Red-shouldered Hawk (E)
	Bald Eagle	Marsh Hawk (E)	Marsh Hawk (E)
		Peregrine Falcon (E)	Peregrine Falcon (E)
		Broad-winged Hawk (T)	Bald Eagle (E)
		Long-eared Owl (T)	Osprey (E)
		Upland Sandpiper (E)	Long-eared Owl (E)
		Blue-winged Warbler (T)	Common Gallinule (T)
			Yellow Rail (E)
			Black Rail (E)
			Black-crowned Night Heron (E)
			Great Egret (E)
			Double-crested Cormorant (E)
			Upland Sandpiper (E)
			Forster's Tern (E)
			Veery (T)
			Brown Creeper (E)
Mammals	Indiana Bat (E)	Indiana Bat (E)	Indiana Bat (E)
		Kneen's Myotis (T)	River Otter (T)
		Evening Bat (T)	
		River Otter (T)	
		Woodland Vole (E)	

E-Endangered T-Threatened

Aquatic habitat types and their acreage include: main channel (2,600 acres); main channel border (18,000 acres); side channel (100 acres); sloughs-side streams, river lakes and ponds, and submergent and floating vegetation (7,500 total acres). Levee bound backwaters are included under sloughs and streams.

The pool is considered to have species rich and populous mussel populations. Mussel records reveal the presence of 25 species in this pool. Commercial harvest of mussels is 6,000 pounds and its estimated value is $400.

There have been 69 species of fish recorded in this pool. Of these, 32 are considered common. Fish utilize every available portion of the pool. However, it is the off-channel areas which provide the essential spawning, rearing, resting and feeding habitat for the majority of species.

Sport fishing provided 673,000 activity days or 35 percent of the total recreational activity. This activity contributed approximately $6.0 million (1975 dollars) to the economy. Species most actively sought by fishermen were crappie, bluegill, channel catfish, and largemouth bass.

The commercial fish harvest was 824,300 pounds and was valued at $199,800. Carp were caught in greatest numbers followed by buffalo and catfish.

While Pool 19 is consistently used each year by birds that remain there year-round or that breed there during spring and summer, its greatest significance is to the diving ducks and migratory waterfowl that obtain their food by diving for bulbs, leaves and small crustaceans. Pool 19 is more than 20 years older than other navigation pools of the Upper Mississippi and has received rich deposits of silt and nutrients as a result of many years of farming along its border. The silty bottom of Pool 19 supports a rich benthic community, including many fingernail clams, and this food supply attracts great flocks of diving ducks to the pool each spring and fall. The upper portion of the pool provides considerable areas of slough and marsh habitat suitable for shorebirds, wading birds, and surface-feeding ducks.

Thousands of waterfowl using the Mississippi Flyway stop briefly to rest and feed in Pool 19 during the spring and fall migrations. Of surface feeding ducks, mallard are most common. Scaup and canvasback use the pool in large numbers. Approximately 23,300 ducks and geese were harvested in 1977 and 30,400 man-days were spent afield seeking waterfowl. Over $328,900 (1975 dollars) were spent in pursuit of waterfowl in this pool.

Upland birds in the pool include pheasant, mourning dove1/ and bobwhite quail. The majority of hunting on the pool takes place on private land. Approximately 12,000 hunter-days were spent afield harvesting 35,000 upland game birds in 1977. This represents $75,000 (1975 dollars) in expenditures.

The pool supports numerous mammal species. Species common in the area include: muskrat, squirrel, raccoon, rabbit, beaver, and white-tailed deer. White-tailed deer find most of the food and protective cover they require in the forested ridges and valleys that flank the river on both shores in the lower third of the pool. Bottomland forests have been mostly removed and replaced by farmlands. Many of the predatory and scavenging animals native to Pool 19 are heavily dependent upon shoreline and marsh habitat to satisfy their food requirements. Most of this habitat is confined to the Burlington Island complex; consequently, the normal movement of these animals between forest, field, and marsh habitats is hindered.

Recreational hunters seeking small game2/ spent 27,000 days afield, representing $170,000 (1975 dollars) in expenditures, and a harvest of 51,000 animals.3/ In addition, 3,000 hunter-days were spent harvesting 460 white-tailed deer. Over $61,000 (1975 dollars) were spent deer hunting. Species harvested for their pelts included muskrat, mink, raccoon, opossum, fox, beaver, skunk, and coyote. Commercial fur harvest amounted to 17,300 pelts valued at approximately $307,000. Approximately 14,100 man-days, representing $48,000 (1975 dollars) in expenditures, were spent harvesting furbearers.

Endangered and/or threatened species in Pool 19 are noted in Table 18.

No acreage has been set aside for wildlife management or protection within the Pool 19 floodplain.

V. J. Pool 20

Terrestrial habitat types and their acreage include: aquatic marshland (35 acres), herbaceous growth (300 acres), forestlands (3,500 acres), agricultural lands (2,000 acres), sand and mud (100 acres), dredge material (100 acres) and developed lands (300 acres).

1/ Iowa does not allow dove hunting.
2/ Includes rabbit, squirrel, and woodchuck.
3/ Woodchuck data not available for this pool.

TABLE 18

Federal and State Endangered and/or Threatened Species
Pool 19

	Federal	Iowa	Illinois
Invertebrates	Higgins' Eye Pearly Mussel (E)		
Fish		Western Sand Darter (T) Pallid Sturgeon (E) Lake Sturgeon (E) Skipjack Herring (T)	Lake Sturgeon (T)
Reptiles		Five-lined Skink (T) Western Slender Glass Lizard (E) Blanding's Turtle (T) Red-eared Turtle (T) Stinkpot (T) Ornate Box Turtle (T) Black Rat Snake (T) Graham's Water Snake (T) Diamondback Water Snake (T) Massasauga (T) Copperhead (E)	
Birds	Arctic Peregrine Falcon (E) American Peregrine Falcon (E) Bald Eagle (E)	Cooper's Hawk (T) Red-shouldered Hawk (E) Marsh Hawk (E) Peregrine Falcon (E) Broad-winged Hawk (T) Long-eared Owl (T) Upland Sandpiper (E) Blue-winged Warbler (T)	Cooper's Hawk (E) Red-shouldered Hawk (E) Marsh Hawk (E) Peregrine Falcon (E) Bald Eagle (F) Osprey (E) Long-eared Owl (E) Short-eared Owl (E) Common Gallinule (T) Yellow Rail (E) Black Rail (E) Black-crowned Night Heron (E) Great Egret (E) Double-crested Cormorant (E) Upland Sandpiper (E) Forster's Tern (E) Veery (T) Brown Creeper (E)
Mammals	Indiana Bat (E)	Indiana Bat (E) Keen's Myotis (T) Evening Bat (T) River Otter (T) Woodland Vole (E)	Indiana Bat (E) River Otter (T)

E-Endangered T-Threatened

Aquatic habitat types and their acreage include: main channel (1,100 acres); main channel border (4,100 acres); side channel (0 acres); sloughs-side streams, river lakes and ponds, and submergent and floating vegetation (1,600 total acres). Levee bound backwaters are included under sloughs and streams.

No formal studies of benthic organisms other than mussels have been conducted in Pool 20. However, catches of plankton-eating fish indicate the presence of Copepoda and Cladocera and catches of sport fish such as white bass, bass, sunfishes and panfish indicate the presence of mayflies and caddisfly larvae. The pool is considered to have a species rich and individually poor mussel populations. Mussel records reveal the presence of 22 species in this pool. Commercial harvest of mussels is negligible.

There have been 67 species of fish recorded in this pool. Of these, 32 are considered common. Fish utilize every available portion of the pool. However, it is the off-channel areas which provide the essential spawning, rearing, resting and feeding habitat for the majority of species.

Sportfishing provided 93,000 activity days or 40 percent of the total recreational activity. This activity contributed approximately $840,000 (1975 dollars) to the economy. Species most actively sought by fishermen were channel catfish, sauger, white bass, and walleye.

The commercial fish harvest was 285,800 pounds and was valued at $43,200. Carp were caught in greatest numbers followed by catfish and buffalo.

Although Pool 20 is consistently used by resident song, shore, and wading birds, migratory waterfowl use the pool only sporadically. The relative lack of backwaters and marshes along this stretch of the river combines with intensive farming to render the Pool 20 area less than ideal bird habitat.

Several thousand waterfowl using the Mississippi Flyway stop briefly to rest and feed in Pool 20 during the spring and fall migrations. Of surface feeding ducks, mallard are most common. Scaup and goldeneye use the pool in minor numbers. Approximately 8,500 ducks and geese were harvested in 1977 and 9,100 man-days were spent afield seeking waterfowl. Over $98,500 (1975 dollars) were spent in pursuit of waterfowl.

Upland birds in the pool include pheasant, mourning dove, bobwhite quail and turkey.1/ Approximately 11,000 hunter-days were spent afield harvesting 17,000 upland game birds in 1977. This represents $69,000 (1975 dollars) in expenditures.

The pool supports numerous mammal species. Species common in the area include muskrat, squirrel, raccoon, rabbit, beaver, opossum,

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1/ Turkey data only available from Missouri.

woodchuck, and white-tailed deer. Raccoon, muskrat, beaver, mink, and opossum depend heavily on the productive marsh and shoreline habitat.

Recreational hunters seeking small game1/ spent 35,300 days afield, representing $222,000 (1975 dollars) in expenditures, and a harvest of 42,900 animals.2/ In addition, 6,300 hunter-days were spent harvesting 520 white-tailed deer. Over $128,000 (1975) dollars were spent deer hunting. Sepcies harvested for their pelts included muskrat, mink, raccoon, opossum, fox, beaver, skunk, and coyote. Commercial fur harvest amounted to 7,800 pelts3/ valued at approximately $131,000. Approximately 11,100 man-days, representing $37,000 (1975 dollars) in expenditures, were spent harvesting furbearers.

Endangered and/or threatened species in Pool 20 are noted in Table 19.

No acreage has been set aside for wildlife management or protection within the Pool 20 floodplain.

V. K. Pool 21

Terrestrial habitat types and their acreage include: aquatic marshland (4 acres), herbaceous growth (200 acres), forestlands (7,100 acres), agricultural lands (1,000 acres), sand and mud (100 acres), dredge material (100 acres), and developed lands (300 acres).

Aquatic habitat types and their acreage include: main channel (1000 acres); main channel border (3,500 acres); side channel (0 acres); sloughs-side streams, river lakes and ponds, and submergent and floating vegetation (2,900 total acres). Levee bound backwaters are included under slough and streams.

The pool is considered to have species and individually poor mussel populations. Mussel records reveal the presence of 16 species in this pool. Commercial harvest of mussels is negligible.

There have been 71 species of fish recorded in this pool. Of these, 30 are considered common. Fish utilize every available portion of the pool. However, it is the off-channel areas which provide the essential spawning, rearing, resting, and feeding habitat for the majority of species.

1/ Includes rabbit, squirrel, woodchuck.
2/ Woodchuck data available for Missouri only.
3/ Due to closed season, no fox data available for Missouri.

TABLE 19

Federal and State Endangered and/or Threatened Species
Pool 20

	Federal	Iowa	Illinois	Missouri
Invertebrates	Higgins Eye Pearly Mussel (E)			
Fish		Western Sand Darter (T) Chestnut Lamprey (T) Lake Sturgeon (E) Skipjack Herring (T) Five-lined Skink (T) Western Slender Glass Lizard (E) Red-eared Turtle (T) Stinkpot (T) Ornate Box Turtle (T) Black Rat Snake (T) Speckled Kingsnake (E) Graham's Water Snake (T) Diamondback Water Snake (T) Massasauga (T) Copperhead (E)	Lake Sturgeon (T)	Lake Sturgeon (E)
Birds	Artic Peregrine Falcon (E) American Peregrine Falcon (E) Bald Eagle (E)	Cooper's Hawk (T) Red-shouldered Hawk (E) Marsh Hawk (E) Peregrine Falcon (E) Broad-winged Hawk (T) Long-eared Owl (T) Upland Sandpiper (E) Least Tern (E) Blue-winged Warbler (T)	Cooper's Hawk (E) Red-shouldered Hawk (E) Marsh Hawk (E) Peregrine Falcon (E) Bald Eagle (E) Osprey (E) Long-eared Owl (E) Short-eared Owl (E) Common Gallinule (T) Yellow Rail (E) Black Rail (E) Black-crowned Night Heron (E) Great Egret (E) Double-crested Cormorant (E) Upland Sandpiper (E) Forster's Tern (E) Veery (T) Brown Creeper (E) Henslow's Sparrow (T)	Cooper's Hawk (E) Marsh Hawk (E) Peregrine Falcon (E) Osprey (E) Sharp-shinned Hawk (E) Double-crested Cormorant (E) Least Tern (E)
Mammals	Indiana Bat (E) Gray Bat (E)	Indiana Bat (E) Keen's Myotis (T) Evening Bat (T) River Otter (T) Woodland Vole (E)	Indiana Bat (E) Gray Bat (E) River Otter (T)	Indiana Bat (E) Gray Bat (E) River Otter (E)

E - Endangered   T - Threatened

Sportfishing provided 528,000 activity days or 31 percent of the total recreational activity. This activity contributed approximately $4.8 million (1975 dollars) to the economy. Species most actively sought by fishermen were crappie, bluegill, channel catfish, and largemouth bass.

The commercial fish harvest was 50,600 pounds and was valued at $7,700 dollars. Carp were caught in greatest numbers followed by buffalo and catfish.

Pool 21 is moderately used each year by many species of birds. For most of its length, Pool 21 is surrounded by drained farmlands. Quincy, Illinois, provides only minor songbird habitat. The lake bays of the Quincy Bay area, north of Quincy, are of moderate value to surface-feeding ducks, shorebirds and wading birds.

Several thousand waterfowl using the Mississippi Flyway stop briefly to rest and feed in Pool 21 during the spring and fall migrations. Of surface feeding ducks, mallards are most common. Scaup, goldeneye, and canvasback return to the pool in minor numbers each year. Approximately 5,600 ducks and geese were harvested in 1977 and 6,600 man-days were spent afield seeking waterfowl. Over $71,000 (1975 dollars) were spent in pursuit of waterfowl.

Upland game birds in the pool include pheasant, mourning dove, bobwhite quail, and turkey1/. Approximately, 8,000 hunter-days were spent afield harvesting 12,000 upland game birds in 1977. This represents $50,000 (1975 dollars) in expenditures.

The pool supports numerous mammal species. Species common in the area include muskrat, squirrel, raccoon, rabbit, beaver opossum, and white-tailed deer.

Recreational hunters seeking small game2/ spent 19,000 days afield representing $120,000 (1975 dollars) in expenditures and a harvest of 23,000 animals.3/ In addition, 3,700 hunter-days were spent harvesting 300 white-tailed deer. Over $75,000 (1975 dollars) was spent deer hunting in this pool. Species harvested for their pelts included muskrat, mink, raccoon, opossum, fox, beaver, skunk, and coyote. Commercial fur harvest amounted to 5,500 pelts4/ valued at approximately $96,000. Approximately 8,100 man-days, representing $27,000 (1975 dollars) in expenditures, were spent harvesting furbearers.

Endangered and/or threatened species in Pool 21 are noted in Table 20.

1/ Turkey data only available from Missouri.
2/ Includes rabbit, squirrel, and woodchuck.
3/ Woodchuck data only available for Missouri
4/ Due to closed season, fox data not available for Missouri.

TABLE 20

Federal and State Endangered and/or Threatened Species
Pool 21

	Federal	Illinois	Missouri
Invertebrates	Higgins' Eye Mussel (E)		
Fish		Lake Sturgeon (T)	Lake Sturgeon (E)
Birds	Arctic Peregrine Falcon (E) American Peregrine Falcon (E) Bald Eagle (E)	Cooper's Hawk (E) Red-shouldered Hawk (E) Marsh Hawk (E) Peregrine Falcon (E) Bald Eagle (E) Osprey (E) Long-eared Owl (E) Short-eared Owl (E) Common Gallinule (T) Yellow Rail (E) Black Rail (E) Black-crowned Night Heron (E) Great Egret (E) Double-crested Cormorant (E) Upland Sandpiper (E) Forster's Tern (E) Veery (T) Brown Creeper (E)	Cooper's Hawk (E) Marsh Hawk (E) Peregrine Falcon (E) Osprey (E) Sharp-shinned Hawk (E) Double-crested Cormorant (E) Least Tern (E)
Mammals	Indiana Bat (E) Gray Bat (E)	Indiana Bat (E) Gray Bat (E) River Otter (T)	Indiana Bat (E) Gray Bat (E) River Otter (E)

E-Endangered
T-Threatened

A total of 8,134 acres have been set aside for wildlife management and protection in Pool 21, which accounts for 50 percent of the floodplain. See Table 9 for a distribution of these lands among various resource agencies.

V. L. Pool 22

Terrestrial habitat types and their acreage include: aquatic marshland (20 acres), herbaceous growth (100 acres), forestlands (7,000 acres), agricultural lands (1,400 acres), sand and mud (40 acres), dredge material (70 acres), and developed lands (200 acres).

Aquatic habitat types and their acreage include: main channel (1,300 acres); main channel border (5,100 acres); side channel (0 acres); sloughs-side streams, river lakes and ponds, and submergent and floating vegetation (1,700 total acres). Levee bound backwaters are included under sloughs and streams.

The pool is considered to have species and individually poor mussel populations. Mussel records reveal the presence of 16 species in this pool. Commercial harvest of mussels is negligible.

There have been 62 species of fish recorded in this pool. Of these, 31 are considered common. Fish utilize every available portion of the pool. However, it is the off-channel areas which provide the essential spawning, rearing, resting and feeding habitat for the majority of species.

Sportfishing provided 123,000 activity days or 37 percent of the total recreational activity. This activity contributed approximately $3.8 million (1975 dollars) to the economy. Species most actively sought by fishermen were crappie, bluegill, channel catfish, and largemouth bass.

The commercial fish harvest was 226,300 pounds and was valued at $46,900 dollars. Carp were caught in greatest numbers followed by buffalo and catfish.

The pool is moderately used each year by resident and migratory birds. While Pool 22 offers a wide variety of bird habitat types, ranging from dry bluff forests to marshy river backwaters, a relative lack of low island and slough habitat discourages heavy use by shore and marsh birds and surface-feeding ducks. The many acres of drained farmland that flank most of the rivercourse provide suitable conditions for many species of songbirds and predatory birds, and the forested bluffs that follow the river provide nesting and roosting habitat to crows, turkey vultures, owls, hawks, and eagles.

Several thousand waterfowl using the Mississippi Flyway stop briefly to rest and feed in Pool 22 during the spring and fall migrations. Of surface feeding ducks, mallard are most common and teal and baldpate share secondary importance. Goldeneye are the most predominate diving ducks. Approximately 10,500 ducks and geese were harvested in 1977 and 10,900 man-days were spent afield seeking waterfowl. Over $118,000 (1975 dollars) were spent in pursuit of waterfowl in this pool.

Upland birds in the pool include pheasant, mourning dove, bobwhite quail, and turkey.1/ Approximately 16,000 hunter-days were spent afield harvesting 24,000 upland game birds in 1977. This represents $101,000 (1975 dollars) in expenditures in this pool.

The pool supports numerous mammal species. Species common in the area include muskrat, squirrel, raccoon, rabbit, beaver, opossum, skunk, woodchuck, and white-tailed deer.

Recreational hunters seeking small game2/ spent 40,000 days afield, representing $252,000 (1975 dollars) in expenditures and a harvest of 26,000 animals.3/ In addition, 7,400 hunter-days were spent harvesting 600 white-tailed deer. Over $150,000 (1975 dollars) was spent deer hunting in this pool. Species harvested for their pelts included muskrat, mink, raccoon, opossum, fox, beaver, skunk, and coyote. Commercial fur harvest amounted to 10,500 pelts3/ valued at approximately $178,000. Approximately, 14,700 man-days, representing $50,000 (1975 dollars) in expenditures, were spent harvesting furbearers.

Endangered and/or threatened species in Pool 22 are noted in Table 21.

A total of 5,268 acres have been set aside for wildlife management and protection in Pool 22, which accounts for 31 percent of the floodplain. See Table 9 for the distribution of these lands among the various resource agencies.

1/ Turkey data available only for Missouri
2/ Includes rabbit, squirrel, and woodchuck.
3/ Wooddhuck data available only for Missouri.
4/ Due to closed season, fox data not available from Missouri.

TABLE 21

Federal and State Endangered and/or Threatened Species
Pool 22

	Federal	Illinois	Missouri
Invertebrates	Higgins' Eye Pearly Mussel (E)		
Fish		Lake Sturgeon (T)	Lake Sturgeon (E)
Birds	Arctic Peregrine Falcon (E)	Cooper's Hawk (E)	Copper's Hawk (E)
	American Peregrine Falcon (E)	Red-shouldered Hawk (E)	Marsh Hawk (E)
	Bald Eagle (E)	Marsh Hawk (E)	Peregrine Falcon (E)
		Peregrine Falcon (E)	Osprey (E)
		Bald Eagle (E)	Sharp-shinned Hawk (E)
		Osprey (E)	Double-crested Cormorant (E)
		Long-eared Owl (E)	Least Tern (E)
		Short-eared Owl (E)	
		Common Gallinule (T)	
		Yellow Rail (E)	
		Black Rail (E)	
		Black-crowned Night Heron (E)	
		Great Egret (E)	
		Double-crested Cormorant (E)	
		Upland Sandpiper (E)	
		Forster's Tern (E)	
		Veery (T)	
		Brown Creeper (E)	
Mammals	Indiana Bat (E)	Indiana Bat (E)	Indiana Bat (E)
	Gray Bat (E)	Gray Bat (E)	Gray Bat (E)
		River Otter (T)	River Otter (E)

E-Endangered
T-Threatened

VI. POOL PROJECTIONS

Pool by pool projections of the status of fish and wildlife resources have not been developed. Basically, the general conditions and trends described in Sections IV.A. through IV.E. will occur in each pool but to varying degrees. The major impacts on fish and wildlife resources will be sedimentation of backwaters and increased floodplain encroachment and degradation of water quality by industrial and urban development. In addition, hunting and fishing pressure will continue to increase in each pool. However, specific impacts and demands on fish and wildlife resources by pool are difficult to project.

The reader is referred to several of the other GREAT II work group draft appendices. The Side Channel Work Group has estimated that 35 percent of all UMR backwater habitat will be lost due to sedimentation and vegetation succession over the next 50 years. This ranges from 0 percent loss in Pool 15 to 54 percent loss in Pool 14.

The Floodplain Management Work Group has estimated population increases in each pool and the resultant increased use of floodplain lands for urban and agricultural use. The Floodplain Management Work Group also describes the increasing constriction of the river channel and its effects on the river habitat.

The Water Quality Work Group documented water quality in various sections of the river and predicted future water quality conditions. The Water Quality Work Group also addressed the effects of changing water quality on different fish species.

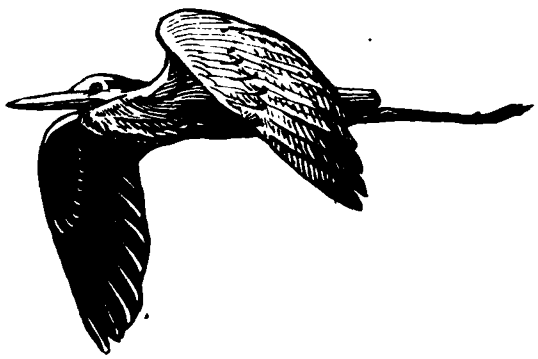
Because decreasing habitat and increasing user pressure appear to be the factors most important in determining future fish and wildlife conditions, the areas where these factors are projected to change the most are particularly critical. These areas may be spread through several pools so the following discussions are not necessarily on a pool by pool basis.

Water quality problems are generally divided into the presence of various pollutants and high levels of suspended sediments. The Water Quality Work Group (WQWG) has identified the area downstream of the Quad Cities as the area in the GREAT II region having the most water quality problems. With increased development in the Quad Cities metropolitan area, the potential for intensification of harmful pollutants also increases . The effect may be a reduction in numbers of fish or their quality for possible human consumption. The zone of this impact is varied, since the extent to which the various pollutants are carried downstream varies.

Main channel sedimentation is generally more severe downstream of Pool 19 because of the large amount of sand entering the system from the Des Moines River and the increased agricultural use of the land in the area. An increase in intensive agricultural practices will probably compound this problem.

Shallow backwaters have been identified as one of the most important habitats for fish and wildlife. According to the Side Channel Work Group (SCWG), there will be a 42 percent decrease in backwater habitat due to sedimentation over the next 50 years in Pools 11 to 14. Since much of the backwater areas are on refuge lands, the desirability of these refuge lands for wildlife production will be reduced. In addition this loss of fish spawning habitat may affect the fish stocks in these pools.

Since hunting and fishing pressure are expected to increase with projected population increases, the areas showing the greatest population increases may have problems meeting the demand for hunting/fishing opportunities. According to the Floodplain Management Work Group projections, Pools 11-17 will average a 31 percent increase in population while pools 18-22 will average only an 8 percent increase. With declining habitat, this increase will lead to a decline in the quality of the fishing/hunting experience in this area.



VII. WORK GROUP ACTIVITIES/ACCOMPLISHMENTS

VII. A. CONTRACTED RESEARCH

VII. A. 1. Collection of Data on Submergent Characteristics-Phase I

Prepared By: Hazelton Environmental Sciences
Primary Investigator: Larry Danek
Contract Let: October 1979
Report Completed: August 1980
Contract Cost: $12,426.00

The lack of submergent data was identified, by the GREAT I Fish and Wildlife Management Work Group, as a significant information gap in the development of a habitat inventory. In this investigation, the contractor reviewed and evaluated existing methodologies and equipment to determine the most appropriate means to:

a. sound and map bottom contours and subsurface features;
b. survey and map the river's substrate;
c. measure and map water velocities; and
d. locate, identify and map submergent aquatic vegetations.

The selected methods were to be economical, time efficient, applicable throughout the UMR and easily updated. The period of time generated data will be valid was to be discussed.

On the basis of information generated above, the contractor provided a Plan of Action (POA) for obtaining each objective in a pilot study area. The POA includes goals, objectives, personnel requirements, equipment, methods, study duration, optimum study periods, and costs (Hazelton 1980a).

VII. A. 2. Collection of Data on Submergent Characteristics-Phase II

Primary Investigator(s): None
Contract to be Let: Contract terminated
Product Due: N/A
Approximate Study Cost: $125,000

On the basis of information gathered in Phase I of this study, the contractor was to implement a field collection program. Deliverables were to include: a report discussing the data collection process and findings; data mapped on stable base overlays; a Plan of Action which reflects the experience gained in the field work, discussing methods, cost time and personnel requirements to gather similar information throughout the Upper Mississippi River.

Phase II was contained in the Hazelton Environmental Science Corp. contract for Phase I. However, based on the Phase I report the FWMWG opted to terminate this portion of the contract. It was the work group's opinion that the time frame mandated by the GREAT II Team was much too short to adequately complete this phase. In addition, the work group did not believe that the POA presented an economically feasible way of mapping the entire UMR.

Although this contract was terminated, the FWMWG supports its concept. Additional investigations in this matter is being done by the UMRBC Master Plan effort.

VII. A. 3. Annotated Bibliography of the Fish and Wildlife Resources of the Upper Mississippi River

Prepared By: Hazelton Environmental Sciences
Primary Investigators: Robert Alberico, George Carpenter
Contract Let: January 1978
Product Completed: September 1979
Contract Cost: $17,412.00

The annotated bibliography was prepared to provide fish and wildlife biologists with a document containing all existing published and unpublished data relating to the fish and wildlife resources of the Mississippi River upstream from Cairo, Illinois. Due to a variety of unforeseen circumstances, the document was not completed until late in the study period.

The completed report consists of three volumes (Hazelton 1979). Volume I is the Annotated Bibliography consisting of 1800 citations. Volume II is the Keyword Thesaurus which is divided into three sections (1) biological, (2) physical-chemical, and (3) geographical. Volume III is an addendum consisting of material which was either added after the final report was submitted or material which was not annotated.

The document provides a very useful source of information to anyone proposing to conduct studies on the UMR. In addition, the report is the primary source document for the literature review study.

VII. A. 4. Review of Fish and Wildlife Literature

Prepared By: Hazelton Environmental Sciences
Primary Investigator: Robert Alberico
Contract Let: September 1979
Product Completed: November 1980
Contract Cost: $29,185.00

This investigation identified, evaluated and collated existing literature (published before May 1978) on life history requirements of fish and wildlife resources of the UMR and man-induced impacts

on these resources. In addition, the contractor identified and discussed information voids in the two aforementioned areas to insure the most important studies are completed first. Further, the contractor was to provide the following information on the 20 information gaps with highest priority: (1) appropriate entity to address them, (2) cooperating entities, (3) objectives, and (4) time and cost required to do the work. However, this portion of the contract was not completed due to the difficulty in determining the top priorities and, in the opinion of the work group, the unfamiliarity of the contractor with the river management agencies (Hazelton 1980b).

VII. A. 5. Study of the Fish in the Main Channel of the Mississippi River

Prepared By: LGL Ecological Research Associates
Primary Investigator: Susan Summers, Randall Howard
Contract Let: May 1979
Product Completed: November 1980
Contract Cost: $65,000.00

This investigation was conducted to increase existing knowledge of fish use of the main channel of the Mississippi River. The following information was provided: (1) relative abundance, diversity, and seasonal variation in fish populations based on catch/unit of effort. Young of the year were separated from adults; (2) a comparison of fish assemblages between sample areas to include relative abundance, diversity and seasonal variation. Interpretation of variation between areas included a discussion of the respective areas physical and chemical variables; (3) an assessment of the value of the main channel to fish, information available in the literature was included in this analysis: and (4) an evaluation of effectiveness of sampling gear.

An interim report covering the first four sampling periods was submitted in September 1979 (Summers 1979). The report discusses the sampling program, species captured, catch per unit of effort, gear effectiveness and alternative types of gear.

Weather conditions from December 1979 to February 1980 made sampling very difficult so that little or no information was obtained.

A summary of significant program findings (LGL 1980) are:

"The main channel habitat in Pool 14 (river miles 500-513.5) of the Upper Mississippi River was sampled to determine the occurrence, distribution and relative abundance of fishes. Gear types used were gill net, trammel net, hoop net, bottom trawl, midwater trawl, seine and electrofisher. Thirty-nine species of fish were caught from May 1979 to April 1980. The most abundant species of 2,692 total fish were channel catfish (59.0%, which were mostly YOY), silver chub (12.0%), mooneye (10.3%), shovelnose sturgeon (9.4%),

freshwater drum (2.5%), flathead catfish (1.7%), and river darter (1.7%). Catch rates and species compositions varied seasonally; the most fish were caught in July (1027) while the fewest were caught in February (4). The low number in February was due mainly to reduced fishing efforts using only gill and hoop nets. Among the six stations sampled the relative abundances of the common fish were similar and cluster analyses indicated that differences in fish relative abundance among stations were small. Species diversity (Shannon-Weaver) increased with distance upstream (H"=1.21 to 1.71) based on annual catches per station. Seasonally, the highest diversity value was in March (H"=2.23) and the lowest value was in August (H"=0.85).

The bottom trawl was the most effective gear type for catching fish; seining and electrofishing were ineffective. The other gear types were intermediate in effectiveness. The main channel had a more diverse fish population than previously reported, but the importance of the fishery resource in the main channel was not quantitatively evaluated.

For future research needs a recommendation was made to perform one or more Adaptive Environmental Assessment Workshops."

In addition based on this study and the experience of the members of the FWMWG, the work group made the following conclusions:

1. The main channel is an important nursery area for channel catfish - the top commercial (in value) and sport (fishermen preference) fish through much of the GREAT II reach.

2. Channel catfish, silver chub, mooneye, shovelnose sturgeon, freshwater drum, flathead catfish and river darter typify the fishery of the main channel. The importance of this habitat to these species must be evaluated.

3. Absence of white bass, walleye, and sauger in any sizable numbers may indicate that (a) bottom trawling is ineffective for these species or (b) for some yet unexplained reason they make extensive use of main channel border but avoid the main channel.

4. Bottom trawling is (to date) the most effective means available to us for sampling the main channel.

5. Bottom trawling in the main channel is an effective economical means of assessing young-of-the-year class strength of channel catfish for use in predictions of future stock available for commercial and sport harvest. (Helms 1975, Pitlo 1979)

VII. A. 6. Classification of Channel Training Structures

Prepared By: Iowa Conservation Commission
Primary Investigator: Tom Boland

Contract Let: June 1979
Product Completed: March 1980
Contract Cost: $33,961.00

This investigation is an initial effort to substantiate the importance of wing dams to aquatic organisms. In addition to providing information on use and interrelationships, the study should provide data to formulate guidelines which will insure the design and construction of new wing dams and modifications to existing wing dams will be beneficial to fish and wildlife resources. The contractor classified and grouped wing dams and closing structures on the basis of their physical characteristics, hydraulic regimen and affect of the structure on the surrounding area.

A total of 595 wing and closing dams were inventoried along the Iowa border. Data indicated that 217 (36 percent) of the dams within the study area had been completely eroded or covered with bottom sediments (32.6 percent) or were physically removed by the Corps (3.8 percent). The remaining dams surveyed (273) were sorted into twelve definable groups. The physical criteria chosen for dam classification included:

a. Depth of water over dam.
b. Location of dam along the river meander (i.e. inside bend, outside bend, straight section).
c. Substrate particle size.

This study will be followed up by research which will investigate utilization of these structures by aquatic organisms and the relationships between the physical/hydrological features and use by organisms. The subsequent biological studies will be done by the Iowa Conservation Commission in coordination with the National Marine Fisheries Service (see FWMWG Recommendation #3025).

VII. A. 7. Wing Dam Modification Study

Prepared By: University of Wisconsin-Stevens Point-USFWS Cooperative Fishery Unit
Primary Investigators: Rodney Pierce, Thomas Hall, Scott Corley
Contract Let: May 1978
Report Due: May 1981 (Phase I theses completed May 1980)
Contract Cost $90,049.00

This investigation is being conducted to ascertain the effect constructing a notch in a wing dam will have on the fishery in the immediate vicinity of the wing dam. In addition, the study should document the affect of notching on bottom sediments, hydrographic relief, water velocity and direction of flow.

The work was divided into two phases. Phase I was supposed to consist of 3 sampling periods in which hydrological, biological

and physical features were collected prior to notching. After the wing dams were notched, Phase II was to consist of sampling as in Phase I.

The wing dams were scheduled for notching and/or repair in October/November 1978. However, the work group was unable to obtain the necessary permits to accomplish the work at that time. Therefore, the structures were not notched/modified until early summer 1979.

The findings of Phase I follow:

"Six wing dams and an adjacent side channel in Pool 13 of the Upper Mississippi River were studied in June, August, and October 1978, and June 1979 in the initial phase (prenotching) of a project to determine the effects of wing dam notching on fish and aquatic community characteristics. Three wing dams were notched in June 1979.

Fifty-two species of fish were caught in the study area with hoop nets, electrofishing gear, and a small-mesh seine. Thirty eight fish species were caught on or near wing dams. Electrofishing provided the widest variety of fish species and hoop netting provided the least. Electrofishing and hoop net catches were influenced by river stage or discharge.

Species composition of the catches changed more dramatically from sampling month to month than between kinds of habitat. Fish were caught in greatest numbers and diversity throughout the study area in August. Centrarchids, especially bluegill, and cyprinids, especially emerald shiners, were most abundant in August. Freshwater drum dominated catches in late October. Electrofishing catch rates and fish species diversity were highest in the side channel, followed by main channel border shorelines and emergent wing dams. The composition of electrofishing catches from the side channel, main channel border shorelines, and emergent wing dams were generally similar. Smallmouth buffalos were most important in hoop net catches near wing dams, and channel catfish, in side channel hoop nets. No bluegill, black crappie, or sauger older than age IV, and one freshwater drum older than IV were caught in the study area (Pierce 1980)."

"Water temperature and dissolved oxygen concentration were uniform with depth in each sampling period but varied among periods. Current velocity varied with sampling period because staff gauge, i.e. discharge, varied with time. Current velocity decreased with depth. The substrate was mainly medium sand because bottom current velocities ranged from 22 to 43 cm/s during 1978.

Fifty-six taxa of macroinvertebrates were collected with a Ponar grab sampler in 1978. Oligochaeta, the most abundant class, comprised 51% of benthic invertebrate density. <u>Hesagenia bilineata</u>

(Say), Hexagenia limbata (Serville), and early instars of Hexagenia spp. made up 64% of the benthic biomass. Hydropsychid caddisflies dominated the macroinvertebrate aufwuchs on basket and multiple-plate samplers, which were placed on wing dams. Basket samplers were colonized by significantly greater macroinvertebrate numbers, biomass, and number of taxa than multiple-plate samplers.

Total benthic invertebrate, oligochaete, Hexagenia spp., and chiromomid density, and biomass and number of benthic taxa each were positively, significantly related to percent silt-clay in the substrate. All of these macroinvertebrate categories were negatively, signficantly related to percent sand in the substrate. Although gravel substrate was rare, the highest benthic invertebrate density, biomass, and number of taxa occurred in gravel. Wing dam 25, on the inside of a river bend in an area of reduced current, had significantly greater benthic density and biomass than for other wing dams because of greater silt-clay deposits there. Wing dam 28 had the lowest benthic density, biomass, and number of taxa and the greatest percentage of sand. Benthic density, biomass, and number of taxa were significantly greater at stations above wing dams than below because percentages of silt-clay were greater above than below.

Besides substrate, discharge and time of year in relation to invertebrate life cycles affected benthic invertebrate populations. Benthic invertebrates decreased in August 1978 and June 1979 partly because of peak discharges in the month before the decrease and partly because of insect emergence.

The wing dams were islands of rock in a sea of sand. Basket samplers collected 26.5 times more macroinvertebrate numbers and 14.3 times more biomass than the Ponar grab sampler in September 1978. These differences were related to habitat, i.e. basket samplers collected invertebrates from a lotic-erosional habitat, and the Ponar grab sampler sampled a lotic-depositional habitat (Hall 1980)."

Phase II data collection was completed in August 1980. Before analyzing the data, Corley (1980) made the following evaluation:

"Notching of wing dams may be beneficial, detrimental, or it may have a negligible effect. Benefits include prevention of sand deposition in side channels and behind wing dams during periods of low flow and scouring of areas where deposition has occurred (Pierce 1980). Detrimental effects are increased deposition of sand and the physical removal of rock which provides substrate for macroinvertebrates and cover for fish (Pierce 1980).

Notching increases sediment deposition when it allows more sediment-laden water into an area without maintaining sufficient velocity to carry the sediment through the area (Simons et al. 1974). Sand is a poor substrate for benthic macroinvertebrates (Hall 1980; [illegible] 1937a; Sprules 1947;

O'Connel and Campbell 1953; Cordone and Kelly 1961; Leonard 1962; Chutter 1969; Hynes 1970; Leudtke and Brusven 1976; Fremling et al. 1978, 1979; Schmal and Sanders 1978). Hall (1980) noted that if notching increases the percentage of sand in the substrate in the study area, bottom-dwelling macroinvertebrates would be adversely affected.

Wing dam height, location of notches in dams, discharge, and location of the dam in relation to the thalweg of a river affect the degree to which sediments are scoured (Simons et al. 1974, Reynolds 1977, Jennings 1979, Hall 1980). Of the three notched dams in the study area, number 25 was submerged throughout the year, and was located on the inside of a river bend in an area of reduced current velocity (Hall 1980). Before notching, the inside of dam 25 had either been eroded away or covered by sand to the point where notching may not have had a significant effect on the performance of the dam. Dams 26 and 28 were emergent during periods of low river stage (discharge) but were submerged for much of the year. The notch in dam 26 began approximately 15 meters from the shoreline whereas the notch in dam 28 was the highest of the dams in the study area. Dam 27, which was not notched and was not studied, was approximately of the same height as dam 26. Dam 27 may have influenced the effectiveness of the notched dams."

Emphasis in determining the results of notching will be placed on analyzing the hydrographic relief, current velocity, substrate, and fish data. These results will be contained in a thesis by Corley.

VII. B. ACTIVITIES UNDERTAKEN BY WORK GROUP MEMBERS

VII. B. 1. Pool Level Fluctuation for Fish and Wildlife Resources -Pool 16

Prepared By: Fish and Wildlife Management Work Group
Primary Investigators: Robert Williamson, Ed Perry, and Rick Breitenbach
Product Due: Weather permitting
Cost: Estimate $1,500.00

The study will investigate the practicality of manipulating pool water levels to enhance fish and wildlife habitat. Because the study relies heavily on weather conditions, it has been delayed three summers. The proposed plan consists of lowering Pool 16 approximately twelve inches at the dam to effectuate a three to four inch drawdown in the Dead Slough area, UMR miles 461.0 to 463.0. Once the water level is drawndown, 300 to 500 acres of exposed mudflats in Pool 16 will be aerially seeded with millet. Reflooded vegetation will provide some marginal fish habitat in the fall and serve as a substrate and nutrient source for phytoplankton and zooplankton production. Plankton are the essence of the river's productivity and the base of a food chain that all other organisms depend on.

Increased density of the vegetative buffer zone bordering the islands and sloughs will decrease erosion and siltation due to wave wash by barges and recreational craft. Bird watching opportunities for game and non-game species will be enhanced. There will be an increase in food available for waterfowl. Increased vegetation densities in shallow open water and on previously unvegetated mudflats will attract minnows and other prey species for great blue herons, great egrets and green herons. Swamp sparrows, song sparrows, long-billed marsh wrens and red-wing blackbirds will feed and rest in the millet. Other birds such as bank swallows, rough-winged swallows, chimney swifts and barn swallows will feed on insects that are attracted to the vegetion.

Water levels will be returned to normal levels approximately three weeks after drawdown. An environmental assessment for the necessary public and regulatory review will be prepared.

This project was considered for implementation each year. However, water levels were either too high, too low or unstable. The U.S. Fish and Wildlife Service, Illinois Department of Conservation and the Rock Island District will continue to find an opportune time to complete this project.

VII. B. 2. Development of a Channel Maintenance Plan

Prepared By: Fish and Wildlife Management Work Group
Primary Investigator: Gail Peterson, Kevin Anderson, and FWMWG
Product Due: Site selection will require continuous updating.

GREAT II spent a considerable amount of time developing a disposal plan for material dredged from the navigation channel. The plan recommends disposal sites, appropriate mitigation, and funds for acquisition of land and equipment.

Participation by the FWMWG in this effort included development of disposal site criteria (Appendix 17) and an evaluation of the Dredge Material Uses Work Group (DMUWG) proposed disposal sites (Appendix 18). The work group reviewed the disposal sites and recommendations were transmitted to the chairman DMUWG. Once all work groups had submitted their respective comments to the chairman DMUWG, a Disposal Site Selection Task Force was created. (The reader is reffered to the DMUWG Appendix and the Plan Formulation Work Group (PFWG) Appendix for a detailed discussion of the activities of this group.) The chairman of the FWMWG was assigned to this task force. FWMWG involvement included participation in the development of a method for fulfilling the National Economic Development and Environmental Quality Objectives as set forth in the Water Resource Council's Principles and Standards and a subjective evaluation of selected disposal sites on the basis of their economic and environmental impacts. The task force conducted a field review of each site to assess practicality, potential problems and site design criteria for disposing material at each site. Final task force selections were submitted to the PFWG. Criteria were developed by the FWMWG to evaluate sites submitted to the PFWG (Appendix 19).

In recognition of equipment limitations, the FWMWG accepted short-term disposal sites (Appendix 20) which were the "least destructive" to fish and wildlife resources. In addition, many long-term sites (Appendix 21) which will impact fish and wildlife resources were accepted by the PFWG for the following reasons:

a. It was generally assumed by most members of the PFWG that agricultural lands were more important than fish and wildlife habitat.
b. There was not sufficient information available to evaluate the option of placing material on levees or storing material behind levees.
c. There was no available information on any disposal method other than hydraulic pipelines; and, therefore, in most instances, site options were restricted to a three-mile range.
d. There was no information available to thoroughly evaluate the option of open water thalweg disposal.

The final GREAT II Channel Maintenance Plan (CMP) is a further refinement of the plan presented by PFWG. The final plan eliminates the need for a short-term plan. It presents a primary disposal plan and sets specific priorities and procedures for alternate site selection. The chairman of the FWMWG continued to participate in this process and assisted the team in selection of primary sites.

In addition, the members of the FWMWG conducted an habitat evaluation of representative dredge material disposal sites. Based on this evaluation, priorities for site selection and mitigation measures were forwarded to the Team for incorporation into the plan. This evaluation also provided the basis for the FWMWG assessment of all alternative CMP's developed in the GREAT II planning process (Appendix 23).

VII. B. 3. Restoration of Backwaters Associated With Stage 3 of the Fulton Flood Control Project

Prepared By: Jointly undertaken by Corps of Engineers, Fish and Wildlife Service, GREAT II FWMWG, SCWG, and the State of Illinois
Principal Investigators: Dave Nelson, Gail Peterson, Gerald Bade, Rick Breitenbach, Bill Bertrand
Dredging Scheduled to Begin: Spring 1981, 3-5 year monitoring program to follow.

Stage 3 of the Fulton Flood Protection Project will include a sand levee running parallel to the Mississippi River south of Fulton, Illinois. As originally proposed, the levee material would have been dredged from the main channel; but an alternate plan, to obtain levee material from backwater sloughs adjacent to the project was recommended. Extracting borrow material from the backwater sloughs will not only meet the prime engineering objective of obtaining levee material but also will meet a secondary biological objective of improving fish and wildlife habitat. Up to several feet of silt overburden must be removed from the sloughs before the sand, needed for levee construction, can be obtained. As presently proposed, the silt overburden will be deposited on low slough islands to raise their elevations 5 to

6 feet. It is considered that the increased elevation will allow the establishment of more diverse productive wildlife habitat. In the process of dredging, the shallow sloughs will be deepened and subsequently improved for fish.

The levee will border a backwater area including Wilson, Cattail, and Sunfish sloughs on the river side. On the landward side, the levee will border the city of East Clinton, agricultural land, a wetland area, and Cattail Creek. At the north end is Cattail Slough Public Use Area which is maintained by the Rock Island District, Corps of Engineers. The levee will need an estimated 603,000 yards of sand borrow and have an average 20-foot height, a 12-20 foot top width, a 120-200 foot base width, a 1 to 4 inside slope and a 1 to 5 outside slope.

Approximately 100,000 yards of silt overburden will need to be removed to obtain the sand borrow from Sunfish, Wilson, and Cattail Sloughs. The waste overburden will be deposited in a minimum of 5 feet deep on 3 sites adjacent to the sloughs. The contractor will need to cut an approximately 5-feet deep by 40-feet wide access channel into Sunfish Slough. An 8-inch dredge will be used for cutting the access channel and a 16-inch or 18-inch dredge with a 2000-2500 feet reach will be used for pumping the levee material.

In the process of disposing of silt overburden, efforts must be made to prevent the material from flowing into adjacent aquatic areas. This will be accomplished by construction of containment levees or by cutting vegetation in such a manner as to inhibit sediment flow. Containment levees will be constructed by pushing up trees and material from inside the disposal site and/or deposition of dredged material. Trees within the disposal site less than 12 inches in diameter will be pushed over and used as part of the containment levee or cut by hand to 4-5 feet above the ground and felled so they lay perpendicular to the sediment flow. Trees cut in this manner should act to slow and filter the sediment. If the ground is dry enough, heavy equipment may be preferred for building containment levees and removing trees within disposal sites. Trees which are to be removed will be marked by the U.S. Army Corps of Engineers and the Fish and Wildlife Resource Agencies. The perimeter of the forested areas to be removed will be flagged or painted. Containment levees will be needed in low areas where sediment flow may occur.

As soon as possible after deposition, water tolerant herbaceous vegetation with a short germination period such as reed canary grass, fescue, or annual rye grass will be seeded on the dredged material. The grass should stabilize the dredged material and prevent it from being washed away during spring floods.

Once the levee is built and the overburden is deposited on the backwater islands, then Phase II, a tree, shrub and herbaceous

planting program, will be initiated. Mast trees such as pin oak, walnut, and hickory will be planted to determine if they will grow in the overburden material and to create wildlife foods and habitat. The planting program will be developed jointly by the U.S. Fish and Wildlife Service and U.S. Army Corps of Engineers. The Waterways Experiment Station-COE, Vicksburg, Mississippi, and the North Central Region, Biological Services Program, U.S. Fish and Wildlife Service, Twin Cities, Minnesota are acting in an advisory capacity on the project. Phase II will be designed as a demonstration project to exhibit the use of dredged material in creating wildlife habitat on backwater islands. These backwater areas which have pure stands of silver maple trees lack the vegetative diversity necessary to support a variety of wildlife . Raising the elevation of backwater areas with silt overburden and planting these areas with a variety of wildlife plants will greatly enhance the area for deer, squirrels, rabbits, and many other species of wildlife. A 3 to 5 year monitoring program will be conducted to evaluate the relative success of Phase II.

VII. B. 4. Interpretation of Aerial Photos to Assess Habitat Changes As a Result of: (1) Encroachment, (2) Dredge Disposal and (3) Sedimentation

Prepared by: Side Channel and Fish and Wildlife Management Work Groups
Principal Investigator: Gerald Bade

The reader is referred to the SCWG Appendix for a detailed discussion of this work.

VII. B. 5. Other Activities

A large number of tasks undertaken by the work group involved review of literature to supplement contracted findings, documenting impacts on fish and wildlife resources and where applicable, assessing current practices and measures to alleviate these impacts. Areas of investigation included: value of backwaters to fish and wildlife; GREAT I SEWG studies entitled <u>Sedimentation Rates in Pools 4-10, Selected Backwater Change in Aquatic Habitat 1939-1973</u> and their discussion on erosion and land treatment; St. Paul and Rock Island Corps of Engineer District's 9-foot EIS's; existing Soil Conservation Service soil erosion control practices and procedures; GREAT I and II SCWG Side Channel Opening efforts; affects of operation and maintenance of the navigation channel on fish and wildlife resources; Corps of Engineers Waterway Experiment Station's

reports on habitat creation using dredge material; GREAT I FWMWG report on habitat creation; GREAT I FWMWG report on effects of water level manipulation; impacts on encroachment on fish and wildlife resources, impacts of water quality on fish and wildlife resources; impacts of commercial and recreational boat traffic on fish and wildlife resources.

VIII. ALTERNATIVES AND RESULTANT RECOMMENDATIONS

VIII. A. FORMULATION OF ALTERNATIVE SOULUTIONS & DEVELOPMENT OF RECOMMENDATIONS PROCESS

The tasks the work group chose to accomplish varied by type of problem being addressed and by the existing knowledge. The work group needed to collect and organize background information. This background information was used to identify further problems, to provide input and data for other work groups and as part of the narrative for the work group appendix. Where little background information existed, baseline data and/or research study needs were identified. Where possible, the baseline data was collected and/or research studies conducted.

As all tasks were completed, the results were distributed to members of the work group. Conclusions were then drawn by members of the work group based on the results of the work groups' tasks.

The conclusions developed by the work group led to the identification and consequent development of potential alternatives to the problems. The results of some tasks indicate there still is not enough available information to ensure a knowledgeable assessment of the potential alternative solutions to a problem. In these cases, no alternatives could be formulated and the only recommendation which could be made was for further study of the problem. The alternatives vary in specificity from site specific guidelines to general policy changes, dependent upon the problem they are addressing. Once an alternative was selected; the rationale for its selection and all available supporting documents, information and studies supporting its selection were identified and displayed. This information (and other), was used to compile a brief summary of the types of impacts that would result if the recommendation were implemented. Based on the impact assessment and careful evaluation of the recommendation the work group, through its voting procedures, either approved or rejected the recommendation.

All work group approved recommendations were sent to the GREAT II impact assessment coordinator for review and advice. The coordinator would then mail this information, complete with comments, back to the work group chairman. The work group then did a more thorough and detailed assessment of the impact potential of their recommendations. The work group was responsible for obtaining or estimating the necessary information for their impact assessment through their studies, work group meetings, discussions with other work groups, discussions with other agencies having expertise in that particular field, discussions with economists and discussions with the impact assessment coordinator.

The recommendations were reviewed by all members of the Plan Formulation Work Group and additions, changes or suggestions were made. The work group chairman made the appropriate revisions and brought a final version of the recommendations to the Plan Formulation Work Group for final evaluation.

VIII. B. RECOMMENDATIONS FOR MAJOR PROBLEMS

The following recommendations, grouped by problem categories, were developed by the work group and approved by concensus to address the major problems discussed in Chapter II. The FWMWG was assigned recommendation numbers 3001-3500. Only numbers 3001 to 3040 were used. The recommendations are not in numerical order, but were assigned numbers as they were developed by the work group. In addition, recommendation 3011 was incorporated into 3009, 3015 into 3029, and 3018 into 3005. (See Appendix 25 for an index of recommendations.)

Included in each recommendation is a discussion and rationale for work group's recommendation and alternatives. In addition a preliminary environmental impact evaluation was completed (part 10). Following each recommendation is an impact assessment form to identify the estimated costs of each recommendation and its broad environmental impacts. All costs are approximate and depend usually on a detailed plan of study. Estimates are in 1979 dollars.

VIII. B. 1. Problem 1

Fish and wildlife are affected by turbidity and sedimentation resulting from upland and streambank erosion.

FWMWG 3003

The FWMWG recommends that the U.S. Department of Agriculture (USDA), U.S. Soil Conservation Service, and U.S. Environmental Protection Agency should intensify their efforts, in the GREAT II watershed to gain acceptance and implementation of no-till and minimum-till farming methods, in order to reduce erosion on all tillable lands.

FWMWG 3002

The FWMWG recommends that off-channel areas be monitored by the U.S. Geological Survey to provide an estimate of sedimentation. If necessary, specific funding and authority should be provided to USGS or the Corps of Engineers (COE) to delegate to USGS. Priorities for monitoring sites are attached to the recommendation.

FWMWG 3035

The FWMWG recommends that as soon as possible the RID should determine specific methods to improve flow and decrease sedimentation and bank erosion at the attached list of backwater and side channel areas. The RID should give priority over other backwater areas to these areas and those listed in FWMWG 3040 in any decision to implement a remedial action.

FWMWG 3036

The FWMWG recommends that the Rock Island District (RID), the U.S. Fish and Wildlife Service (FWS) - Upper Mississippi River Wild Life and Fish Refuge (UMRWLFR), and Iowa Conservation Commission (ICC) should develop a plan to protect the Brown's Lake complex by constructing a new levee using dredge spoil material. Development of the plan would depend on its compatibility with the management objectives of the UMRWLFR and the ICC.

FWMWG 3006

The FWMWG recommends the COE be given the authority and the specific funding to modify backwaters recommended by the FWIC and approved by the USFWS and the adjoining states.

FWMWG 3028

The FWMWG recommends that the COE initiate a research and development program to determine the equipment (or pieces of equipment or equipment system) necessary for performing large scale backwater alterations.

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3003

Pool Number All

River Mile District-wide

Date Approved by Work Group 3/21/80

Studies have shown that the fine sediment reaching the backwaters of the Upper Mississippi comes from the surrounding farmlands in the drainage basin (LePage, 1979). It, therefore, stands to reason that the primary effort in combatting this problem is to treat it at the source.

More topsoil is now being lost from agricultural land each year than was lost in the worst of the dust bowl years. This problem threatens to become more acute as the demands of the world market push up U.S. food production, causing more intensive cultivation, and bringing into use marginal land that is more susceptible to erosion. The energy crisis adds to this demand as grain alcohol is used for gasohol (Senator John Culver, 1979).

Soil conservation practices currently exist which could reduce soil erosion by 50% if applied to 100% of tilled lands. However, new techniques have been developed that could reduce erosion by 90% if applied to 100% of tilled lands. (LePage, 1979 and Lindstrom, et al. 1979).

No-till and conservation till farming practices reduce erosion by leaving crop residues in the field over winter. With minimum disturbance to the soil, spring planting is accomplished in one operation. Pilot projects have shown that these techniques can be employed with little or no reduction in overall yield. A realistic goal of treatment of 80% of tilled lands with conventional and new conservation techniques should be set.

The FWMWG recommends that the U.S. Department of Agriculture (USDA), U.S. Soil Conservation Service, and U.S. Environmental Protection Agency should intensify their efforts, in the GREAT II watershed to gain acceptance and implementation of no-till and minimum-till farming methods, in order to reduce erosion on all tillable lands.

1. General problem addressed:

   (1) Fish and wildlife are affected by turbidity and sedimentation resulting from upland and streambank erosion.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

Recommend the implementation of practices and programs which reduce upland erosion and its associated impacts on fish and wildlife resources.

4. Tasks accomplished to address problem:

Review literature to assess value of backwaters, review current SCS programs; document losses from aerial photographs, review GREAT I Sediment and Erosion Work Group (SEWG) studies.

5. Listing of alternatives to problem:

   a. USDA, Soil Conservation Service, and U.S. Environmental Protection Agency should intensify their efforts, in GREAT II watershed to gain acceptance and implementation of no-till and minimum-till farming methods, in order to reduce erosion on all tillable lands.

   b. Continue promoting historic conservation practices such as terraces, strip-cropping, and grass waterways.

   c. No action.

6. Selected alternative ____a____.

7. Rationale for selection of alternative:

The primary source of material filling backwaters comes from the erosion within the watershed of each of the UMR tributaries. Current tilling practices are the major cause of this erosion. Due to the value of the UMR, US SCS and US EPA should intensify their efforts in the basin to prevent the current severe erosion losses.

8. References used to select alternative:

GREAT I SECWG draft appendix
U.S. SCS programs and practices
U.S. EPA 208 planning
LePage, et al (1979)
Lindstrom et al (1979)

9. Rationale for elimination of other alternatives:

   b. & c. Current levels of effort and existing practices are only to achieve tolerable levels of erosion. The maximum achievable level should be the goal to protect the backwaters of the UMR.

10. Preliminary impact assessment of selected alternative:

Intensifying efforts of USDA, U.S. SCS, and U.S. EPA will not have any significant environmental impacts. Additional funding to

these agencies may be necessary. Costs (extra management) to the farmer in implementation may be offset by the benefits (time and cost savings, conservation of moisture, and fewer equipment needs). Extensive long-term benefits to fish and wildlife in preservaton of backwater habitat would result.

RECOMMENDATION #3003
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Costs Erosion Control	$	See Sediment and Erosion	Control Work Group.		
Indirect Altered river hydraulics					
Protection of fish and wildlife resources	Acres and habitat quality	Loss of 10,000 - 20,000 acres in the past 40 years. Reduced habitat quality	Projected 12,000 to 28,000 additional acres lost due to sedimentation. Decrease in riverine habitat diversity	Approximately 4,000 to 8,000 acres will still be lost (assumes 70% decrease in sedimentation resulting from erosion). Some reduction in habitat quality	Protection of up to 14,000 acres of backwater habitat. Preservation of present habitat quality

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3002

Pool No. All

River Mile District-Wide

Date Approved by Work Group 1-16-80

The Side Channel Work Group in its Side Channel Inventory identified numerous aquatic areas which are in critical need of remedial action lest they be lost due to the deposition of fine sediment. This study, however, did not enable the work group to accurately project the productive life expectancy of these of other backwaters sites or allow priorities to be placed on them when considering which sites should be rehabilitated first. One means of arriving at such conclusions is by estimating the rate of sedimentation in a given backwater and applying this knowledge to the physical characteristics of the site. This would allow resource managers to predict how much aquatic, moist soil, or terrestrial habitat would remain after a given time period and at what point remedial action should be taken to preserve the values being managed for.

Any of the methods described by the Sediment and Erosion Work Group (SEWG) of GREAT I could be utilized or an alternate method of comparing aerial photographs at 5-year intervals and measuring the changes in vegetation could be used. Since most backwater areas are extremely shallow, sedimentation will be represented by changes from open water to marsh or moist soil vegetation and then to pioneer woody vegetation. However, in some cases 5 year intervals of observation may be too long as complete succession may occur in that period. Therefore, a continual monitoring program is necessary to characterize backwater losses and rates of loss. This data would serve as a basis on which to refine priorities of backwater restoration.

The FWMWG recommends that off-channel areas be monitored by the U.S. Geological Survey to provide an estimate of sedimentation. If necessary, specific funding and authority should be provided to USGS or the Corps of Engineers (COE) to delegate to USGS. Priorities for monitoring sites are attached.

1. General problem addressed:

    (1) Fish and wildlife are affected by turbidity and sedimentation resulting from upland and streambank erosion.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

    To recommend the type of action and the methodology necessary to determine the proper action to alleviate problems associated with off-channel sedimentation.

4. Tasks accomplished to address problem:

Review existing literature, historic and recent aerial photography, and GREAT I Sediment and Erosion Control Work Group (SECWG) report.

5. Listing of alternatives to problems:

a. No action
b. Off-channel areas be monitored by the U.S. Geological Survey (USGS) to provide an estimate of sedimentation. If necessary, specific funding and authority should be provided to USGS or the COE to delegate to USGS. Priorities for monitoring sites are attached.

6. Selected alternative __b__ .

7. Rationale for selection of alternative:

The value of backwater habitat to fish and wildlife has been documented in scientific literature. In an artificially controlled riverine system, the quality of the habitat must also be artificially maintained. The information gained by monitoring the off-channel habitat will identify sites being impacted in the future and can aid in establishing priorities on sites already identified.

8. Refernces used to select alternative:

FWMWG Discussion
GREAT I SECWG Appendix
Ritchie, J.C. "Sediment, Fish, and Fish Habitat." Journal of Soil and Water Conservation, May-June 1972, Vol 27, No 3.

9. Rationale for elimination of other alternatives:

(a) Will not meet the objective. Criteria need to be established to correctly select backwaters which are threatened by severe sedimentation and are in need of restoration.

10. Preliminary impact assessment of selected alternative:

The only impact of a monitoring program is the cost of equipment, personnel and supplies to conduct hydrographic surveys or (other means) to determine sedimentation rates.

This increased knowledge of the riverine system and the factors contributing to its destiny could lead to management decisions to restore particular backwaters. These impacts are evaluated under FWMWG 3006.

RECOMMENDATION #3002
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Cost of equipment, personnel supplies, travel and et cetera to conduct hydrographic surveys, interpret aerial photography, and communicate the knowledge and experience of river resource managers	$	No comprehensive and coordinated monitoring currently takes place	No change	Equipment-$3000/yr 60 man days @ $100/day laboratory costs-$500/site monitor one site each pool on 2 year cycle (total of 24 sites) to run depth transects and take sediment samples and write report	$14,500/yr
Indirect Additional knowledge for improved decision-making	None	Currently very little data regarding sedimentation rates and life expectancy of backwaters	Data may be gained but slowly and haphazardly	Data will enable decision-makers and resource managers to better provide for environmental values in their planning process	Increased ability to make management decisions based on sound data. Enhancement and preservation of fish and wildlife resources

Suggested Monitoring Sites

(SCWG Priority 2 Sites[1])

Pool	Site	River Mile
11	Swift Slough	614.5 L
	Goetz Slough	612.5 R
	Unnamed	612.3-612.0 L
	Unnamed	610-611 R
	Jack Oak Island	604.9-605.7 L
	N. Buena Vista	604.3 R
	Sand Cut	604.0 L
	Coal Pit Chute	602.5 L
	Kruse's Bar	601.3 L
	Unnamed	600.3 L
12	Molo Slough	574.2 R
	Below Menominee River	574.0 L
	Nine Mile Island	572.6 R
	Deadman Slough	569.0 L
	Below Sinsinawa River	566.7-569.0 L
	Stone Slough	563.5 L
	Aiken's Landing/Wise Lake	561.5-562.5 L
	Wise Lake Cut	560.8 L
	Above Lock & Dam 12	556.7-560.0 L
13	Unnamed	550.7 R
	Casey's Island	550.1 R
	Savanna Proving Grounds	546.5 L
	Brown's Lake Complex	544-546 R
	Marcus Bottoms Entrance	543.3 L
	Savanna Bay/Miller's Bay	539.5-541.0 L
	Santa Fe Island/Lainsville Light	540-541.5 L
	Boy Scout's Island	538.8 R
	Sabula/Keller's Island Area	535.6-540.0 R
	Savanna Island	533.5-537 I
	Savanna Slough	531-533.5 I
	Cook's Island	532 R
	Big Slough	531 L
	Thomson	528.0 L
	Potter's Slough	524-526 L
	Michelson's Landing	523.8 R
14	Unnamed	521.5-522.5
	Johnson Creek	521.5-522.5 L
	Joyce's Island	519.5 R
	Little Rock Island	518.7 L
	Unnamed	517.3 L
	Sunfish Slough/Beaver Island	516.8 R
	Hanson Slough	509.5 R
	Cordova Nuclear	505.9 L

[1]These are sites which are losing habitat values at a slower rate than Priority 1 sites and should be monitored.

Monitoring Sites Continued.

Pool	Site	River Mile
14	Streamboat Slough	504.5 R
	Cordova Slough	503.9 R
	Cordova Slough	503.8 R
15	No Sites	
16	Arsenal Island	482.7 L
	Davenport Harbor	480.5 R
17	Muscatine Island	453-454 L
	Blanchard Island Chute	452.3 L
	Kilpeck Island	448 R
	Bogus Island	441-444 L
18	Keg Island	436 R
	Willow Bar/Maples Island	426 L
	Johnson Island	420-421 R
	Camp Island	419.7 R
	Benton Island	419 L
19	Swift Slough	410 R
	Willow Bar Island	406 L
	Gulfport	405 L
	Shokokon Slough	402 L
	Millman's/Vaughn Lake	397-400 L
	Turkey Chute	395-396.5 L
	Tyson Creek	383.0 L
	Rabbit Island	379.5 R
	Devil's Creek	377 R
	Chaney Creek	365 L
20	Grey Chute	358.3 R
	Kusie Island	357.5 L
	Huff Island	348.0 L
	Blue Goose Island	316.5 L
	Missouri Chute	346 R
21	Canton Chute Upper	342 L
	Dave's Chute	341 L
	Smoot's Chute	340.5 L
	Little LaGrange Island	339.5 L
	Wyaconda River	337.3 R
	LaGrange Island	337 L
	Cottonwood Island	329.5-330.5 R
22	Orton Island	323.5 R
	Goose Island	318.5 R
	Whitney Island	315.5 R
	Turtle Island	312-313 L
	Zeigler/Glaucus Island	311.9 R
	Unnamed	302-302.5 L

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3035

Pool Number All

River Mile District-wide

Date Approved by Work Group 3/21/80

The Side Channel Work Group, as well as the public, has identified many backwater areas which are in critical need of remedial action due to natural and man-induced sedimentation. It has been estimated by various authors that backwater lakes, ponds and sloughs will be completely converted to terrestrial vegetation within 100 years (Ekblad, GREAT I Sediment and Erosion Work Group, 1979; Bellrose, et. al, 1977). In a riverine system that has been altered and controlled by man, the quality of fish and wildlife habitat must also be artificially maintained.

The Side Channel Work Group of GREAT II developed criteria to evaluate backwater areas in critical need of remedial action to preserve or restore valuable habitat (see SCWG recommendation 3504). Of the 48 sites given highest priority for remedial action, sedimentation is a primary cause for habitat losses at 37 sites. Studies are necessary to determine the appropriate methods/solution. In addition the RID will require necessary funding and authority (see FWMWG 3012).

The FWMWG recommends that as soon as possible the RID should determine specific methods to improve flow and decrease sedimentation and bank erosion at the attached list of backwater and side channel areas. The RID should give priority over other backwater areas to these areas and those listed in FWMWG 3040 in any decision to implement a remedial action.

1. General problem addressed:

   (1) Fish and wildlife are affected by turbidity and sedimentation resulting from upland and streambank erosion.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   (4) Identify and discuss alteration methods and measures which will improve habitat in off-channel areas.

4. Tasks accomplished to address problem:

   (1) Review existing literature concerning use of backwaters by fish and wildlife resources (2) Review historic and recent

aerial photographs of GREAT II study area (3) Review GREAT I SEWG reports (5) Review GREAT I & II SCWG reports.

5. Listing of alternatives to problem:

   a. As soon as possible the RID should determine specific methods to improve flow and decrease sedimentation and bank erosion at the attached list of backwater and side channel areas. The RID should give priority over other backwater areas to these areas and those listed in FWMWG 3040 in any decision to implement a remedial action.

   b. Also include SCWG Priority 2 sites in alternative a.

   c. No action.

6. Selected alternative: a

7. Rationale for selection of alternative:

   High turbidity and sedimentation has already caused extensive losses of aquatic habitat in these areas. If allowed to continue, the areas will succeed to bottomland forest habitat, already in abundance, in the near future.

8. References used to select alternative:

   SCWG II draft appendix
   FWMWG discussion

9. Rationale for elimination of other alternatives:

   b. Priority 2 sites are not in immediate danger of great habitat losses. All attention and planning should focus on Priority 1 sites.
   c. Will not preserve valuable habitat.

10. Preliminary impact assessment of selected alternative:

    Studing potential methods for remedial action will not have any significant impacts. Site specific analysis for each alteration will be necessary. Altering backwaters will have impacts similar to those described in FWMWG 3027.

SCWG Priority 1B Sites

Sites which have lost considerable value due to "natural" causes. These sites will continue to loose habitat value at a rapid rate. Remedial action is required immediately if the area is to be preserved.

Pool	Site	River Mile
11	Ackerman's Cut	613.9 L
	Cassville Slough	612-614 L
	Goetz Island-Side Channel	614.5 R
	Jack Oak Slough	605.9 L
	Bertom Lake	602.5 L
	Unnamed	599.5 L
12	Stump Island	582.0 L
	Industrial Chemical Light	578.0-579.0 L
	Harris Slough	564-566 L
13	Lainsville Slough	545.8 R
	Pin Oak Lake	541.9 R
	Spring Lake Levee	531-534 L
14	Sunfish/Cattail Slough	516-518 L
15	No Sites in Priority 1B	
16	Andalusia Island	463.5-466.5 L
	Dead Slough	461.5-464.0 L
	Wyoming Slough	458-461.0 R
	Drury Slough	459-461 L
17	Blanchard Island	449 L
18	Sturgeon or Boston Bay	433-434 L
	Unnamed	429.2-430.8 R
	Blackhawk Island	427 R
	Kingston Bar	424 R
	Campbell Island	419.5-423.3 L
19	Otter Slough	407-409 R
	Unnamed	394.5 R
	Grape Island	391 R
20	Taylor Chute	353 L
	Huff/Hunt Islands	349-350 L
21	Bear Creek Recreation Area	341.0 L
	Long Island	333.5 L
	Teal Island	332.5 L
	Triangle Lake	330 L
	Broad Lake/Quincy Bay	328.0-329.2 L
	Monkey Chute	325.0 R
22	Texas Chute	324.0 L
	Beebe Island	316.7-318.5 L
	Unnamed	316.0 L

RECOMMENDATION #3035 and 3040
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Cost of administrative functions including design, engineering, hydraulics, coordination, and constracting services, plus 100% overhead	$	Currently Corps has no authority nor administration for backwater alteration projects	No change	One man/year $60,000	$60,000/year
Indirect Cost of alterations	$	No cost	No change	Unable to assess until decisions of type of action can be made	Unknown
Preservation/enhancement of fish and wildlife habitat	Acres	4100 - 4600 acres have suffered habitat losses at SCWG priority 1 sites	Additional acreage will be lost	3500 - 4000 acres can be maintained or restored to productive backwater habitat	Maintenance or restoration on 3500 - 4000 acres
Preservation/enhancement of recreation use	Acres	Access to 4100 - 4600 acres of backwaters has been lost or severely degraded	Access to additional acreage will be lost	Access can be restored or maintained to 3500 - 4000 acres	Restore or maintain access to 3500 - 4000 acres

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3036

Pool No. 13

River Mile 544 - 546 rb

Date Approved by Work Group 3-3-80

The Brown's Lake Complex is a backwater complex directly downstream from the Green Island Levee and Drainage District, Jackson County, Iowa (Pool 13, RM 544.0-546.0 rb). Most of the area is included in the Upper Mississippi River Wild Life and Fish Refuge (UMRWLFR). A small portion is under cooperative agreement for management with the Iowa Conservation Commission (ICC). Studies by the ICC have shown that the Complex supports a diverse fishery and provides valuable wildlife habitat. However, this productive backwater may be lost due to rapid sedimentation.

This sedimentation seems to be caused by high turbulence during flood stages at the lower end of the Green Island levee which directs excessive silt loads onto the Brown's Lake complex. To protect this area the ICC has proposed construction of a levee from Green Island Levee along the right bank of the Lainesville Slough to the Iowa Bluff using dredged spoil material. The levee system must also contain a water control structure to allow natural ingress and egress of fish species during critical times of the year, allow for water control manipulation to benefit both fish and wildlife, and maintain small boat access.

The FWMWG recommends that the Rock Island District (RID), the U.S. Fish and Wildlife Service (FWS) - Upper Mississippi River Wild Life and Fish Refuge (UMRWLFR), and Iowa Conservation Commission (ICC) should develop a plan to protect the Brown's Lake Complex by constructing a new levee using dredge spoil material. Development of the plan would depend on its compatibility with the management objectives of the UMRWLFR and the ICC.

1. General problem addressed:

   (1) Fish and Wildlife are affected by turbidity and sedimentation resulting from upland and streambank erosion.

2. Sub-problem addressed:

   The Brown's Lake backwater complex in Pool 13 has severely silted.

3. Sub-objective addressed:

   (1) Recommend measures to identify critical areas needing restoration.

4. Tasks accomplished to address problem:

(2) Review Historic and recent aerial photographs of GREAT II area.
(5) Review GREAT I & II's side channel opennings reports.

5. Listing of alternatives to problem:

a. The RID, US FWS, UMRWLFR, and ICC should develop a plan to protect the Brown's Lake Complex by constructing a new levee using dredge spoil material. Implementation of the plan would depend on its compatibility with the management objectives of the UMRWLFR and the ICC.
b. no action

6. Selected alternative ___a___.

7. Rationale for selection of alternative:

Brown's Lake Complex is rapidly filling with sediment. A levee surrounding the area may help protect this productive backwater.

8. References used to select the alternative:

FWMWG discussion.
Claflin, Thomas O. 1979. Lake Onalaska Rehabilitation Feasibility Study. River Studies Center, U.W. - LaCrosse, WI 43p.
Boland, Thomas L. and Gaylen F. Reetz. 1979. Species Composition, Catch-Per-Unit-Effort and Seasonal Distribution of the Fishes of Brown's Lake and the Green Island Drainage District.

9. Rationale for elimination of other alternatives:

b. Heavy siltation will continue and will result in the eventual succession of the Brown's Lake Complex to a forested, dry floodplain.

10. Preliminary impact assessment of selected alternative.

Development of a plan will not have any significant environmental impact. If a levee is constructed from dredge spoil material, it could have the following impacts:

Physical - construction of approximately 3 miles of sand levee. Reduction in dredged material disposal at alternative sites. Reduced siltation at site.
Habitat - direct loss of bottomland forest habitat at levee site. Protection of over 700 acres of wetland and aquatic habitat from eventual succession to bottomland forest habitat.

Fish - protection of spawning and nursery habitat.
Wildlife - protection of waterfowl feeding and nesting habitat.
Endangered Species - no impact
Benthos and Other Resources - protection from additional siltation.
Water Quality - improvement through reduced siltation and turbity.
Air and Noise - minor construction impacts only.
Energy - minor construction impacts only.
Aesthetics - maintenance of diversity of habitat.
Management Areas - potential for improvement through water control capability and preservation and enhancement of habitat.
Recreation - potential to sport fishery. Improved waterfowl hunting.
F & W Commercial - possible improved fishing and trapping through protection of habitat
Economic - no significant impact. Maintenance dredging requires disposal with or without proposed levee.
Community - no significant impact.
Social - no significant impact.

RECOMMENDATION #3036
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
<u>Direct</u> Administrative costs of study	man-days ($175/man-day)	0 man-days	10 man-days by Iowa Conservation Commission to evaluate $1,750	230 man-days ($40,250)	+ 220 man-days (+ $38,500)
	THIS SITE IS INCLUDED IN THE GREAT II CHANNEL MAINTENANCE PLAN (CMP). SEE PLAN FORMULATION WORK GROUP APPENDIX FOR COMPLETE ASSESSMENT.				
<u>Indirect</u> Dredging costs	$	Disposal may occur at site No containment	Disposal may occur at the site. No containment or levee construction	Included in CMP. Containment required and levee constructed if appropriate	+ Cost of containment and levee construction
Levee repair and maintenance costs	$	Sites need maintenance	Cost of material and transport borne by management agencies	Cost borne by COE-Channel Maintenance Plan	Cost savings to management agencies. No additional cost to COE.
Reduction in siltation	acres	High sedimentation rates results in loss of habitat	Continued sedimentation	Reduction in sedimentation in area	Reduced backwater acreas lost to sedimentation
Improved management of area set aside for fish and wildlife	habitat quality	Maintenance needed to meet management objectives	Maintenance needed to meet management objectives	Improved habitat through management activities and reduced siltation	Improved habitat quality
Improved waterfowl hunting	waterfowl hunting quality	Hunting quality affected by management capabilities	Status quo	Some improvement through maintenance.	Some improved hunter quality

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3006

Pool Number All

River Mile District-Wide

Date Approved by Work Group 1-16-80

The backwaters of the Upper Mississippi River (UMR) provide the most valuable fish and wildlife habitat of the river corridor, but are rapidly being lost due to high sedimentation rates. These severe losses are likely to continue if remedial action is not forthcoming. On a long-term basis, FWMWG #3003 should significantly reduce this rate of loss. However, short-term action is necessary to preserve this valuable habitat.

Backwater habitat can be preserved and enhanced by several measures. Training structures for maintenance of the nine-foot channel can be modified to improve flow into an area. Side channel oppennings could be made. Dredging of sediment could be accomplished. However, in order to accomplish these goals, the authority and funding must be given to an implementing agency. In view of their expertise in riverine engineering, the U.S. Army Corps of Engineers (COE) is the likely choice. However, before such improvements can be made, the Corps must be given legal authority to do so. Under existing law, the Corps is restricted to projects affecting navigation. Backwaters and slough improvements cannot be made unless they are for maintaining the navigation channel. The Corps should have "maintenance and enhancement" of fish and wildlife habitat included as part of their project purpose (also see FWMWG #3012).

Recommendations and planning for backwater modifications should be based on information obtained in FWMWG 3002, 3027, 3035 and 3040 and the criteria established in Side Channel Work Group (SCWG) 3504. The fish and wildlife interagency committee (FWIC) should be responsible for making recommendations to Rock Island District (RID) and ensuring that fish and wildlife resources will receive maximum benefit. The RID should take no action unless approval is recieved from U.S. Fish and Wildlife Service (USFWS) and the adjoining states.

The FWMWG recommends the COE be given the authority and the specific funding to modify backwaters recommended by the FWIC and approved by the USFWS and the adjoining states.

1. General problem addressed:

   (1) Fish and Wildlife are affected by turbidity and sedimentation resulting from erosion on uplands and streambanks.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

Recommend and encourage the implementation of navigation project operation and maintenance programs and practices which preserve, restore, or enhance fish and wildlife resources.
Identify and discuss alteration methods and measures which will improve habitat in off-channel areas.

4. Task accomplished to address problem:

Review Soil Conservation Service Programs; Review literature to ascertain value of backwaters; Review Sediment and Erosion Work Group - GREAT I Sediment Budget studies; Review aerial photos to document losses.

5. Listing of alternatives to problem:

a. The COE should be given the authority and specific funding to modify backwaters as recommended by FWIC and approved by the USFWS and the adjoining states.
b. Same as a. but delete funding.
c. Provide another agency with authority and funding.
d. Same as a., but without FWIC, FWS and state input.
e. No action.

6. Selected alternative a .

7. Rationale for selection of alternative:

Backwater sedimentation has been accelerated by construction, operation and maintenance of the navigation channel and poor agricultural practices.
Funding and authorization are necessary to rectify these impacts.

8. References used to select alternative:

See tasks
FWMWG discussion

9. Rationale for elimination of other alternatives:

b. Funds are provided on anticipated work loads. Unanticipated work can be substantial and funds are stretched or projects deleted to remain within the budget. Without specific designation of funds for this work, funds could be reprogramed to areas of "higher priority".
c. Unrealistic to staff and equip another agency in view of the COE experience, expertise and equipment in water resource planning.

d. Would put COE in position of making all decisions. Fragments authority for management of fish and wildlife resources on the UMR.
e. Would not meet objectives.

10. Preliminary impact assessment of selected alternative.

Delegation of authority and appropriation of funds to the COE will not have any significant impacts. However, resultant backwater modifications will have the impacts similar to those described in 3027.

RECOMMENDATION #3006
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct					
Cost of administrative functions including design and engineering, coordination, hydraulics and contracting	$	Currently Corps has no authority nor administration for altering backwaters	No change	Planning for modification of backwaters recommended by FWIC $60,000/year	+ $60,000/year
Indirect					
Preservation/enhancement of fish and wildlife habitat	acres	SEE FWMWG RECOMMENDATIONS 3027, 3035 AND 3036 FOR ASSESSMENT OF BACKWATER ALTERATIONS			

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3028

Pool Number All

River Mile District-wide

Date Approved by Work Group 3/21/80

In order to combat the rapid and pervasive sedimentation of backwater areas, it will be necessary to perform alterations to backwater habitat on a large scale. The problem arises of the non-existence of equipment that can perform alterations to backwater habitat on a large scale and in a cost efficient, environmentally sound manner.

The following specifications for equipment would be suitable for backwater alterations:

a. Shallow Draft
b. Capable of long distance (out-of-floodplain) disposal
c. Capable of handling large volumes
d. Self-propelled
e. Capable of handling logs and stumps

It seems highly probable that the development of such a piece of equipment could also answer some of the problems identified with spoil disposal from main channel dredging (e.g. barge loading, out-of-floodplain disposal) as well as adapting it to other earth moving tasks (oil shale mining).

At the present time there is no incentive for private enterprise to develop such equipment. Therefore, the U.S. Government would be the logical choice with the expertise available at the Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi.

The FWMWG recommends that the COE initiate a research and development program to determine the equipment (or pieces of equipment or equipment system) necessary for performing large scale backwater alterations.

1. General problem addressed:

   (1) Fish and wildlife are affected by turbidity and sedimentation resulting from upland and streambank erosion.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   (4) Identify and discuss alteration methods and measures to improve habitat in off-channel resources.

5. Listing of alternatives to problem:

   a. The Corps of Engineers should initiate a research and development program to determine the equipment (or pieces of equipment or equipment system) necessary for performing large scale backwater alterations.
   b. Rely on existing COE equipment.
   c. Rely on private enterprise to develop the equipment for altering backwaters.

6. Selected alternative: a

7. Rationale for selection of alternative:

   Existing COE equipment cannot perform large scale backwater alterations in a cost efficient, environmentally sound manner.

8. References used to select alternative:

   FWMWG discussion
   SCWG II draft appendix

9. Rationale for elimination of other activities:

   b. Current equipment will not meet objectives
   c. There is no incentive

10. Preliminary impact assessment of selected alternative:

   Researching and possibly developing necessary equipment will not have any significant environmental impacts. The COE may require additional funding. If an acceptable piece(s) of equipment is found, its utilization may have impacts similar to those described in FWMWG 3027.

RECOMMENDATION #3028
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Cost of program	$	No incentive to develop equipment for working in backwaters	No change	$100,000 and up depending on level of development (i.e. concept design specifications prototype)	$100,000
Indirect Eventual cost of equipment	$	No equipment available	No equipment developed	Pending results of this study	Pending
Conservation, rehabilitation enhancement of backwater habitat	Acres	Approximately 9000 acres of backwater areas have been or are being vegetated as a result of fine sediment accumulation	An additional 19000 acres are expected to be lost	Many acres of habitat can be preserved with the proper equipment	Preservation, enhancement, rehabilitation of an unknown acreage of backwater habitat pending funding and equipment availability
Channel maintenance and spoil disposal		Use of 20" dredge precludes options such as long distance pumping and barge loading	Emphasis on hydraulic dredging with increased distance capability	New technology may be applicable to barge loading of spoil or out of floodplain disposal	Decreased environmental impacts and increased productive uses of material

VIII. B. 2. Problem 2

Fish and wildlife are affected by operation and maintenance practices associated with the nine-foot channel project.

FWMWG 3012

The FWMWG recommends that the Corps be provided the needed authority and means to establish fish and wildlife as a project purpose of the nine-foot channel project, provided that all measures carried out under this purpose are coordinated fully with and agreed to by all agencies having state and federal fish and wildlife resource management responsibilities in the area.

FWMWG 3019

The FWMWG recommends that the RID eliminate the unwanted disposal of dredge spoils on state and federal lands designated as refuge or management areas for fish and wildlife resources.

FWMWG 3001

The FWMWG recommends that in order to preserve existing fish and wildlife habitat, the Corps of Engineers should request the necessary appropriations to determine and subsequently purchase effective and efficient dredging equipment or contract with private firms to accomplish same. Furthermore, all state and federal agencies should seek Congressional support for the Corps request.

FWMWG 3004

The FWMWG recommends that a Fish and Wildlife Interagency Committee (FWIC) be designated to provide direction and guidance regarding fish and wildlife matters associated with main channel dredging, spoil disposal, physical river modifications, backwater modifications, and river management studies and investigations. The FWIC should be composed of fish and wildlife biologists from Minnesota, Wisconsin, Iowa, Illinois, Missouri, U.S. FWS and Corps of Engineers. Funding should be sought by the Upper Mississippi River Basin Commission (UMRBC) and made available to the agencies to accomplish this work.

FWMWG 3005

The FWMWG recommends that the COE be given the funding to improve fish and wildlife habitat modified/destroyed by placement of dredged material. Sites and methods for restoration should be recommended by Fish and Wildlife Interagency Committee (FWIC). First priority should be given to past disposal sites on state and federal refuge and management lands.

FWMWG 3007

The FWMWG recommends that the RID include fish and wildlife needs in any decision to repair, alter, or construct training or revetment structures. During the planning process, the FWIC should be consulted. In addition, the FWIC may make recommendations to alter structures specifically for the benefit of fish and wildlife resources.

FWMWG 3008

The FWMWG recommends that the RID evaluate all recurrent dredging sites to determine if training structures or other methods such as channel realignment, could reduce dredging in the area. Where beneficial, appropriate training structures should be repaired or constructed in accordance with FWMWG Recommendation #3007.

FWMWG 3009

The FWMWG recommends that the RID, in coordination with the federal and state resource agencies, assess the impact of controlled water level changes on fish and wildlife resources of each pool of the UMR and reevaluate District operating policies. The work group further recommends that the fish and wildlife interagency committee develop criteria using the District's assessment and evaluation. The District should adopt these criteria if they are acceptable to federal and state resource agencies. The criteria should protect and enhance fish and wildlife resources consistent with the mandate to maintain navigation.

FWMWG 3010

The FWMWG recommends that the Corps of Engineers-RID utilize dredge material to maintain, repair, or upgrade levees surrounding the following state and federal refuge and management areas:

1) Spring Lake-River Mile 531.7 to 534.6 LB-Upper Mississippi River Wild Life and Fish Refuge.
2) Green Island-River Mile 546.0 to 548.5 RB-Iowa Conservation Commission
3) Princeton-River Mile 503.5 to 506.0 RB-Iowa Conservation Commission
4) Odessa-River Mile 435 RB-Iowa Conservation Commission
5) Keithsburg-River Mile 428 to 431 RB-Iowa Conservation Commission

FWMWG 3040

The FWMWG recommends that as soon as possible the RID determine specific methods to improve flow and decrease sedimentation at the attached list of backwater and side channel areas. The RID should give priority over the other backwater areas to these sites and those listed in FWMWG 3035 in any decision to implement a remedial action.

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3012

Pool Number All

River Mile District-wide

Date Approved by Work Group 1/16/80

The U.S. Congress designated that the Upper Mississippi River should be maintained as a sanctuary for wildlife, wildflowers, and fish, citing its rich and varied habitat (U.S. Congress, 1924). Several years later, Congress also authorized the Corps to develop a 9-foot navigation channel on this same stretch of river but without making fish and wildlife a project purpose. The past and present methods of dredging and dredged material disposal used by the Corps to maintain this navigation channel often result in destruction of fish and/or wildlife habitat (Appendix 373; Grunwald, 1976; and U.S. Army Corps of Engineers, 1974). To protect the rich and varied habitat in a manner consistent with the direction of Congress, operation and maintenance (O&M) practices of the 9-foot channel which do not harm habitat need to be adopted by the Corps.

It is essential to obtain Congressional authority and funding for the COE 9-foot channel project to recognize fish and wildlife resources as part of the project purpose. This is especially necessary if the recommendations of GREAT II are to be fully implemented.

The FWMWG recommends that the Corps be provided the needed authority and means to establish fish and wildlife as a project purpose of the 9-foot channel project, provided that all measures carried out under this purpose are coordinated fully with and agreed to by all agencies having state and federal fish and wildlife resource management responsibilities in the area.

1. General problem addressed:

   (2) Fish and wildlife are affected by O & M practices associated with the 9-foot navigation project.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   Recommend and encourage the implementation of navigation project O & M programs and practices which preserve, restore or enhance fish and wildlife resources.

4. Tasks accomplished to address problem:

All FWMWG tasks

5. Listing of alternatives to problem:

   a. The Corps should be provided the needed authority and means to establish fish and wildlife as a project purpose of the 9-foot channel project provided that all measures carried out under this purpose are coordinated fully with and agreed to by all agencies having state and federal fish and wildlife resource management responsibilities in the area.

   b. No change

6. Selected alternative ___a___.

7. Rationale for selection of alternative:

Impacts of navigation channel are well known. Without the authority to incorporate fish and wildlife resource work as normal operation and maintenance activities, fish and wildlife habitat will continue to decline.

8. References used to select alternative:

GREAT I FWWG appendix
Aerial photography interpretation
GREAT I-SECWG report documenting aquatic habitat changes - sedimentation rates/causes
FWMWG Appendix

9. Rationale for elimination of other alternatives:

   b. Will not affect desired change.

10. Preliminary impact assessment of selected alternative:

Reauthorization itself does not have any specific impacts. Indirect impacts such as administrative costs, construction, and improved habitat quality are dependent on the specific enhancement measures undertaken. The reader is referred to those FWMWG recommendations that recommend enhancement projects.

RECOMMENDATION #3012
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Authorization has no impacts					
Indirect Enhancement of fish and wildlife resources	habitat quality	No authority for overall riverine enhancement	Status quo	Selected enhancement of fish and wildlife resources	Improved habitat quality

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3019

Pool Number All

River Mile District-wide

Date Approved by Work Group 1/16/80

Placement of dredge spoil disposal on areas managed for fish and wildlife resources has adversely affected fish and wildlife habitat and in some cases has limited the management of the areas. Approximately 58% of all historic disposal has occurred on state and federal fish and wildlife refuge and management areas. The habitat quality at these disposal sites has been reduced or completely destroyed. In addition, dredge spoil erosion from wave action and/or flood waters has compounded sedimentation of backwater habitat. Overall dredge spoil disposal is not compatible with the objectives and intended use of the areas.

The Federal and State refuges or management areas should be protected by eliminating all unwanted spoiling of dredged material, It is anticipated that in some instances dredge material will be requested for use in wildlife management purposes of these areas (see FWMWG 3010) for levee maintenance and other improvements to facilities. It is recognized that in an emergency dredging situation disposal on a management area may be the least damaging spoil alternative. If the Fish and Wildlife Interagency Committee (FWIC) makes this determination, mitigation measures should be evaluated and the Rock Island District (RID) should compensate the refuge or management areas for habitat values lost.

The FWMWG recommends that the RID eliminate the unwanted disposal of dredge spoils on state and federal lands designated as refuge or management areas for fish and wildlife resources.

1. General problem addressed:

   (2) Fish and wildlife are affected by O&M practices associated with the 9-foot navigation project.

2. Sub-problem addressed:

Dredge spoil is placed on islands and shore areas on state and federal lands managed as refuge for fish and wildlife. This unwanted disposal may destroy valuable fish and wildlife habitat and degrade environmental quality on refuge lands.

3. Sub-objective addressed:

Recommend and encourage the implementation of navigation project operation and maintenance programs and practices which preserve, restore, or enhance fish and wildlife resources.

4. Tasks accomplished to address problem:

Participate in selection of short and long-term dredge disposal sites. Review literature to assess effects of 9-foot navigation channel on fish and wildlife. Review historic and recent aerial photos.

5. Listing of alternatives to problem:

a. Continue current Corps O&M dredge spoil practices.
b. Eliminate the unwanted disposal of dredge spoils on state and federal lands designated as refuge or management areas for fish and wildlife resources.
c. Eliminate all disposal on management areas.

6. Selected alternative __b____.

7. Rationale for selection of alternative:

Approximately 1000 acres on state and federal fish and wildlife areas were impacted by spoil placement between 1956 and 1975. The habitat quality has been reduced or completely destroyed by the spoil. Wave action may be eroding spoil and causing additional sedimentation to backwater areas of fish and wildlife habitat value.

No action would continue to deteriorate fish and wildlife habitat on refuges.

8. References used to select alternative:

U.S. Fish and Wildlife Service. 1963. Upper Mississippi Dredge Spoil Survey, A Spec. Rept. on Fish and Wildlife Resources. 3pp.
Upper Miss. River, Conserv. Comm. 1969. Upper Miss. River Dredge Spoil Survey. 4pp.
Dredge Mat. Uses Work Group, GREAT II. 1979. Dredge Material Uses Appendix. Draft Rept. 126pp.
Aerial photo interpretation
FWMWG discussion

9. Rationale for elimination of other alternatives:

(a) will result in further loss of habitat and possible increase in recreational use.
(c) would not allow for beneficial uses, such as levee repair.

10. Preliminary impact assessment of selected alternative:

The selected alternative will have the following:

Physical - reduction of spoil disposal at site. Reduced erosion potential at site. Probable increased disposal at another site.
Habitat - Protection of habitat of management areas. Possible loss of habitat at alternate sites. However, most alternate sites are contained sites on the main shores and would not have similar secondary impacts to backwater areas. Reduction in impacts of encroachment from recreational use of site.
Fish - Protection of feeding and spawning areas.
Wildlife - Benefit by reduced disposal disturbance, protection of habitat, reduction of induced recreation encroachment.
Endangered Species - Protection of bald eagle roost trees.
Other Resources - Slight benefit to benthos from decreased sedimentation.
Water Quality - Beneficial in areas adjacent to management areas.
Air & Noise - No impact
Energy - Possible increased distance to alternate disposal site.
Aesthetics - No visual intrusion of spoil disposal at management areas. Possible increased visability at alternate sites.
Management Areas - Preservation of existing habitat.
Recreation - Loss of beach sites. Minor benefit to sportfishing.
Commercial Fish and Wildlife - Minor benefit to commercial fishing. Benefit to trapping harvest.
Economic - Potential for increased disposal costs. (See CMP)
Community - Alternative disposal sites may adversely affect community resources.
Social - Protection of cultural Sites.

Alternate sites are assumed to be those selected in the Channel Maintenance Plan (CMP) prepared by Plan Formulation Work Group (PFWG) which do not occur on refuge or management lands. For an environmental impact assessment of those sites see the CMP.

RECOMMENDATION #3019
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Protection/Preservation of fish and wildlife habitat	acres	spoil disposal has impacted approximately 1,000 acres of refuge and management lands between 1956-1975	Additional 2,610 acres impacted assuming historical practices and a linear relationship	All material disposed in accordance with GREAT II Channel Maintenance Plan	Preserve or protect 2,610 acres of habitat on refuge and management areas
Costs: Cost of equipment, operation and maintenance costs, energy use, availability of material for productive uses, and removal of other lands from productive use.	$	SEE CHANNEL MAINTENANCE PLAN	FOR SPECIFIC COST ASSESSMENT		

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3001

Pool No. All

River Mile District-Wide

Date Approved by Work Group 3-3-80

Dredging and dredged material disposal is a continuous channel maintenance operation. It has been documented that if dredged material is placed on environmentally sensitive areas, the value of the areas' habitat is degraded or lost. Often there is no alternative to this disposal method, because all dredging in the Rock Island District-Corps of Engineers (RID) is done by the large dredge WA Thompson.

The Material and Equipment Needs Work Group (MENWG) of GREAT II is studying various environmental constraints for disposal and has inventoried available dredging equipment. However, the MENWG has concluded that by using the existing Corps dredging equipment Corps has inadequate capabilities to dredge and dispose of dredged material in a manner which is both economically feasible and environmentally desirable. Without suitable equipment, many beneficial use sites cannot be reached. Also, more material will remain in the floodplain.

The FWMWG recommends that in order to preserve existing fish and wildlife habitat, the Corps of Engineers should request the necessary appropriations to determine and subsequently purchase effective and efficient dredging equipment or contract with private firms to accomplish same. Furthermore, all state and federal agencies should seek Congressional support for the Corps request.

1. General problem addressed:

   (2) Fish and Wildlife are affected by O&M practices associated with the 9-foot navigation project.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   (2) Recommend and encourage the implementation of navigation project O&M programs and practices which preserve, restore, or enhance fish and wildlife resources.

4. Tasks accomplished to address problem:

   (7) Literature search.
   (8) Literature review.

5. Listing of alternatives to problem:

   a. Continue current disposal practices utilizing existing dredging and disposal equipment.

   b. Continue to use existing dredging and disposal equipment and contain all material on historic disposal sites.

   c. In order to preserve existing fish and wildlife habitat, the Corps of Engineers should request the necessary appropriations to determine and subsequently purchase effective and efficient dredging equipment or contract with private firms to accomplish same. Furthermore, all state and federal agencies should seek Congressional support for the Corps request.

6. Selected alternative: ___c___ .

7. Rationale for selection of alternative:

   Although several measures can be taken to mitigate environmental damages caused by dredging with the WA Thompson, the impacts of dredging could be substantially reduced by using other dredging methods.

8. References used to select alternative:

   Annual Dredge Disposal Review
   FWMWG Discussion
   MENWG draft appendix
   GREAT II draft report.

9. Rationale for elimination of other alternatives:

   a. Continue to result in loss of habitat

   b. Construction of containment structures will destroy habitat through peripheral encroachment. Material will still be subject to flood flows.

10. Preliminary impact assessment of selected alternative:

    Alternative equipment will provide the RID with disposal capability that will preserve fish and wildlife resources. For a specific impact discussion, see MENWG draft appendix and the environmental assissment for the channel maintenance plan.

RECOMMENDATION #3001
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Protection/preservation of fish and wildlife habitat	Acres	Spoil disposal has impacted approx. 1800 acres between 1956-1975 (90 ac/yr)	Additional 4500 acres impacted assuming historical practices and a linear relationship	a) majority of material removed from floodplain b) put to beneficial use	Preserve and protect 4500 acres of habitat
Cost of equipment	$	Equipment currently available	Continue to use available equipment	(i.e.) $1,800,000 for new 16" dredge and 3 miles of plastic pipe (exact recommendation depends of MENWG study)	$1,800,000
Operation and Maintenance	$	O & M costs of dredge W.A. Thompson	Continue with current practices	Acquisition, site preparation and transport costs unknown. O&M costs of equipment.	Unknown
Energy use		Unknown	No increase	Additional energy used	Increase by some some unknown amount
Availability of material for productive uses	$	Limited use of material other than for beach nourishment	No change	Existing demand for 10,093,390 cubic yards an average value of $2.62=$26,444,682	$26,444,682
Removal of other lands from productive use	Acres	None	None	a) total RFFP assuming 12' spoil depth=776 acres b) selected RFFP per CMP=387 acres	a) 776 acres b) 387 acres

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3004

Pool No. All

River Mile District-Wide

Date Approved by Work Group 1/16/80

In the past, significant adverse affects to the fish and wildlife resources and habitat of the Upper Mississippi River (UMR) have resulted from COE channel maintenance activities. Many of these impacts could have been mitigated if the COE had coordinated channel maintenance activities with the U.S. Fish and Wildlife Service (USFWS) and the state conservation agencies. The GREAT II On-Site Inspection Team has begun to provide this necessary coordination. However, there are channel maintenance activities other than dredging that should also be coordinated.

As the GREAT recommendations regarding dredging and main channel modifications are implemented, frequent consultation will be needed on fish and wildlife resources. A specific coordinating team will be needed to respond quickly in providing direction as to which course of action will best protect fish and wildlife resources. This will minimize delays when responsive direction and consulations are needed. In addition, there will be a continuing need for coordination of broad scope river management studies and investigations. Such an interagency group will be critical in developing and facilitating research too comprehensive for any one agency to handle.

The FWMWG recommends that a Fish and Wildlife Interagency Committee (FWIC) be designated to provide direction and guidance regarding fish and wildlife matters associated with main channel dredging, spoil disposal, physical river modifications, backwater modifications, and river management studies and investigations. The FWIC should be composed of fish and wildlife biologists from Minnesota, Wisconsin, Iowa, Illinois Missouri, USFWS and Corps of Engineers (COE). Funding should be sought by the Upper Mississippi River Basin Commission (UMRBC) and made available to the agencies to accomplish this work.

1. General problem addressed:

   (2) Fish and Wildlife are affected by operation and maintenance practices associated with the nine-foot navigation channel.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   Recommend and encourage the implementation of navigation project

operation and maintenance programs and practices which preserve, restore or enhance fish and wildlife resources. Recommend the implementation of interagency fish and wildlife committee to coordinate programs and practices.

4. Tasks accomplished to address problem:

(2) Review historic and recent aerial photos to determine habitat loss from channel maintenance.
(5,7,8,9,11,15) Search and review literature to assess effects of channel maintenance and the potential for fish and wildlife enhancement projects.
(14) Participate in selection of short and long-term dredge disposal sites.

5. Listing of alternatives to problem:

a. No action
b. A Fish and Wildlife Interagency Committee (FWIC) should be designated to provide direction and guidance regarding fish and wildlife matters associated with main channel dredging, spoil disposal, physical river modifications, backwater modifications, and river management studies and investigations. The FWIC should be composed of fish and wildlife biologists from Minnesota, Wisconsin, Iowa, Illinois, Missouri, U.S. FWS and COE. Funding should be sought by the UMRBC and made available to the agencies to accomplish this work.

6. Selected alternative ___b___ .

7. Rationale for selection of alternative:

Lack of coordination between COE channel maintenance activities of the 9-foot channel project with fish and wildlife management objectives of USFWS and the states has resulted in adverse effects to fish and wildlife resources and habitat.

8. References used to select alternative:

GREAT II FWMWG Report
GREAT I FWWG, Sediment and Erosion Control Work Group Reports
Literature and aerial photo inspection
Results of OSIT

9. Rationale for elimination of other alternatives:

(a) Will not meet the objective.

10. Preliminary impact assessment of selected alternative.

Establishment of the FWIC will not have any significant environmental impacts. It will require additional funding and personnel. Actions and recommendations by the FWIC will help to preserve, protect, and enhance fish and wildlife habitat of the UMR.

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GREAT RIVER ENVIRONMENTAL ACTION TEAM (GREAT II) UPPER MISSISSI--ETC(U)

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RECOMMENDATION #3004
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Administrative costs for participation from 7 agencies	$	less than 10% of river biologists' time spent on channel maintenance and river studies	status quo 161 man-days/year ($28,175)	1610 man-days/year ($281,750/year, assumes at least 1 full-time person/ each agency for GREAT II area)	+ 1449 man-days (+ $253,575)
Indirect Protection of fish and wildlife habitat	SEE OTHER FWMWG RECOMMENDATIONS THAT THIS COMMITTEE WILL PROVIDE INPUT TO.				

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3005

Pool No. All

River Mile District-side

Date Approved by Work Group 1-16-80

Significant amounts of fish and wildlife habitat have been lost by the indiscriminate placement and disposal of dredged material. The GREAT II channel maintenance plan will provide a means to lessen these severe impacts in the future. However, this does not negate the losses that have already occurred. Many of the past disposal sites are relatively sterile sand piles that impede effective management for fish and wildlife resources. Further, they are an additional source for habitat destruction through erosion, redeposition, and induced recreational use.

The FWMWG recommends that the COE be given the funding to improve fish and wildlife habitat modified/destroyed by placement of dredged material. Sites and methods for restoration should be recommended by a fish and wildlife interagency committee (FWIC). First priority should be given to past disposal sites on state and federal refuge and management lands.

1. General problem addressed:

   (2) Fish and wildlife resources are adversely affected by operation and maintenance practices associated with the navigation channel.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   Recommend and encourage the implementation of navigation project operation and maintenance program and practices which preserve, restore, or enhance fish and wildlife resources.

4. Tasks accomplished to address problem:

   Review aerial photographs to document habitat losses, literature search and review, contracted studies - notch wing dams, main channel, submergent characteristics, habitat creation review, short-long term disposal site selection, water level manipulation study, aquatic habitat changes 1939-1973, Fulton Flood Control Project.

5. Listing of alternatives to problem:

   a. The Corps of Engineers should be given the funding to improve fish and wildlife habitat modified/destroyed by the placement of dredged material. Sites and methods for restoration should be recommended by the FWIC. First priority should be given to past disposal sites on state and federal refuge and management lands.
   b. Provide authority and funding to other agencies to accomplish the work.
   c. Continue existing practices and procedures.

6. Selected alternative: a

7. Rationale for selection of alternative:

   Habitat has been lost by the indiscriminate placement of dredged material. Funding will be needed to rectify these adverse impacts.

8. References used to select alternative:

   FWMWG Discussion
   Aerial photographs document habitat loss.
   Aquatic habitat changes 1939-1973
   Fulton Flood Control Project

9. Rationale for elimination of other alternatives:

   b. Unrealistic to staff and fund another agency in view of the Corps of Engineers experience, engineering expertise, and equipment capabilities. COE has existing authorization.
   c. Currently no effort is being made.

10. Preliminary impact assessment of selected alternative:

   Improvement of habitat modified/destroyed by placement of dredged material will have the following impacts:

   Physical - Protection of disposal sites from floodflows may be necessary at some sites as well as some reshaping of sites to promote revegetation.
   Habitat - revegetation of sites to improve disposal sites' habitat value. Priority given to refuge and management sites will improve the overall value of these areas.
   Fish - fishery habitat may be protected by protecting sites from erosion and subsequent deposition in aquatic areas. Over 600 acres have been impacted in the past.
   Wildlife - reestablishment of wildlife habitat on approximately 1200 acres of dredge spoil disposal that is essentially all sand. Revegetation has been precluded due to site characteristics and time since disposal.

Endangered Species - reshaping of sites may preserve bald eagle roost trees.
Benthos & Other Resources - protection through reduced erosion potential.
Water Quality - minor protection through reduced erosion potential.
Air & Noise - no impact.
Energy - minor use in revegetation and reshaping of sites.
Aesthetics - beneficial by elimination of large barren sand piles.
Management Areas - reestablishment of habitat.
Recreation - minor benefit to hunters.
F&W Commercial - minor benefit to trappers.
Economic - no significant impact.
Community - no impact.
Social - no impact.

RECOMMENDATION #3005
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Administrative costs of planning and design	man-days/year $175/day/year	no mitigation of past disposal sites $0	no change $0	30 man-days/year for 5 years $26,250	+ 150 man-days + $26,250
Cost of reshaping and revegetation	$	$0	$0	$140,000 (700 acres @ $200/acre)	$140,000
Indirect Reestablishment of fish and wildlife habitat	acres	0 acres	0 acres	approximately 1,000 acres reestablished or restored (i.e. backwater flow)	+ 1,000 acres

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3007

Pool Number All

River Mile District-Wide

Date Approved by Work Group 1-16-80

Training and revetment structures have adversely affected valuable fish and wildlife habitat of the UMR. These structures were constructed to aid in maintenance of the nine-foot channel. In some cases wing dams or closing dams have significantly reduced flows in side channels and backwater areas causing severe siltation and resultant habitat losses (see Side Channel Work Group Appendix). In addition, revetment works usually preclude valuable riparian vegetation.

On the other hand, some training and revetment structures provide a quality substrate for aquatic invertebrates. If these structures do not sand or silt in, a diverse benthos population may result which provides attractive feeding habitat for many species of fish.

To reduce the adverse impacts of these structures on fish and wildlife resources, proper planning is necessary to minimize and enhance the environment. To optimize benefits to both navigation and fish and wildlife resources, the Rock Island District-Corps of Engineers (RID) should include fish and wildlife needs (i.e., flow, substrate, bank cavities, etc.) in any decision to repair, alter or construct training or revetment structures. These actions should be fully coordinated with the Fish and Wildlife Interagency Committee (FWIC). In addition, the RID should request the FWIC to recommend alterations based upon expertise and results from FWMWG tasks 11 and 12 and biological studies related to FWMWG task 12. Guidelines for shore protection follow this recommendation. Guidelines for training structures will be developed after the results of the FWMWG wing dam study are evaluated.

The FWMWG recommends that the RID include fish and wildlife needs in any decision to repair, alter, or construct training or revetment structures. During the planning process, the FWIC should be consulted. In addition, the FWIC may make recommendations to alter structures specifically for the benefit of fish and wildlife resources.

1. General problem addressed:

   (2) Fish and wildlife are affected by operation and maintenance practices associated with the nine-foot navigation project.

2. Sub-problem addressed:

Modifications or construction of training or revetment structures are undertaken without thought to possible impacts on fish and wildlife or measures to reduce or offset those impacts.

3. Sub-objective addressed:

Recommend and encourage the implementation of navigation project operation and maintenance programs and practices which preserve, restore, or enhance fish and wildlife resources. Recommend the implementation of interagency fish and wildlife committee to coordinate programs and practices.

4. Tasks accomplished to address problem:

(2) Review historic and recent aerial photographs of GREAT II Study area.
(9) Review literature to assess affects of construction of the nine-foot channel including its operating and maintenance on fish and wildlife.
(11) Study effect of notching wing dams on aquatic organisms.
(12) Classify wing dams according to physical and hydrological features.

5. Listing of alternatives to problem:

a. No action.
b. To optimize benefits to both navigation and fish and wildlife resources, fish and wildlife needs should be included in any decision to repair, alter or construct training or revetment structures and the FWIC consulted.
c. The FWIC may make recommendations for alterations that will benefit fish and wildlife resources.
d. Alternative b. and c.

6. Selected alternative: d

7. Rationale for selection of alternative:

Valuable fish and wildlife habitat has been lost due to training (wing dam) and revetment work (documented in tasks 2. and 9.), but consideration for fish and wildlife during designing and construction of these structures could reduce or possibly even eliminate these habitat losses. The FWIC would make recommendations based upon expertise and results from Tasks 11. and 12., and biological studies related to Task 12.

8. References used to select alternative:

-Upper Mississippi River 9-foot navigation channel, operations and maintenance EIS.

-Tasks 2. and 9.
-Work group discussions.
-Upper Mississippi River Conservation Committee (UMRCC) Fish Section discussions.
-Fish and Wildlife Coordination Act
-FWMWG pending wing dam study results.

9. Rationale for elimination of other alternatives:

(a) Does not meet objective.
(b) and (c) Do not individually address the problem in its entirety. Decisions to alter training and revetment structures can be induced for either environmental or navigation reasons.

10. Preliminary impact assessment of selected alternative:

Recommendation itself does not have any significant environmental impacts. However, potential repair, alteration, or construction of training structures could include: 1) bringing structures up to grade and reducing backwater flows, 2) increasing backwater flows by notching, or 3) reducing siltation by constructing to certain levels, etc. These actions could have the following impacts:

Physical - Potential increase in flow to backwater areas and reduction of sedimentation. Creation of rocky substrate at site.

Habitat - Protection of riparian habitat. Reduction in loss of aquatic backwater habitat, thereby decreasing rapid wetland succession in these areas. Increased habitat diversity.

Fish - Improved or maintenance of feeding, spawning, and cover habitat.

Wildlife - Improved or maintenance of riparian habitat benefiting furbearers and shorebirds. Waterfowl benefits in potential for improved benthos population.

Endangered Species - Potential protection of *Lampsilis higginsii*. Minimize loss of bald eagle roosting trees.

Other Resources - Reduced siltation rate in backwaters may improve benthos habitat.

Water Quality - Beneficial with increased flow and reduction in sedimentation.

Air & Noise - Minor construction activities only.

Energy - Minor construction activities only.

Aesthetics - Potential benefit with more pleasing revetment structures.

Management Areas - Consistent with management objectives. Beneficial in preservation of habitat.

Recreation - Improved backwater access.

Economic - Not significant. Cost of alterations beyond normal operation and maintenance costs. Administrative costs.

Community - No significant impact.

Social - No significant impact.

Guidelines for Revetment Structures*

1. Riprap shore protection shall consist of clean, natural rock with acceptable bedding material.

2. If broken concrete is used as bedding material, all reinforcing rods shall be cut flush with the surface of the concrete and no other extraneous materials shall be contained within the broken concrete materials utilized.

3. Bedding material shall be covered by at least 18" of clean rock riprap.

4. Riprap materials will be at or less steep than a 1:1 slope.

5. If a bulkhead and fill is used, the bulkhead must be completed prior to placement of fill. Fill material will be limited to sands, gravels, natural clays and silts, clean rock; and be free of any organic or inorganic compounds detrimental to aquatic life.

6. The RID should consider the advantages of other methods of bank stabilization such as use of mats, straw or mulch, or specific vegetation best adapted for use.

7. In connection with a stabilization project, consideration shall be given to modifications in design and placement of protection for fisheries benefit as a method of reducing or mitigating adverse impacts. Protection methods that minimize destruction of natural habitat include flow control structures, vane dikes, window revetments, artificial hardpoints, composite bankline revetments, sand fill revetments, filter cloths, tree retards and permeable timber jetties.

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*To be coordinated with the FWIC on a site specific basis. Guidelines for Training Structures will be developed after completion of FWMWG Tasks 2. and 9.

RECOMMENDATION #3007
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Cost of administrative functions including design and engineering, coordination, hydraulics and contracting	$	Corps currently designs and builds regulatory structures without fish and wildlife in mind	Corps may design new structures with fish and wildlife in mind but will not alter old structures	Any decision to build repair, or alter regulatory sturctures will include fish and wildlife needs. Administrative costs will be minimal	Minimal administrative costs
Indirect Preservation and enhancement of fish and wildlife resources	habitat quality	Some structures are beneficial to fish and wildlife and some are adverse	Status quo. Some consideration given as a result of Iowa wing dam study	Improved design of structures to lessen losses and enhance fish and wildlife resources	Improved habitat quality

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3008

Pool Number ______All______

River Mile ______District-Wide______

Date Approved by Work Group ____1-16-80____

Maintenance of the nine-foot navigation channel has required disposal of dredged material on valuable fish and wildlife habitat. Side Channel Work Group-GREAT II (SCWG II) has estimated that 1,800 acres of backwater habitat has been lost to dredged material between 1956 and 1975. Numerous other acres of bottomland forest habitat have been affected as has aquatic habitat; however, evaluation by aerial photos is difficult in these instances.

Some sites can recover from a single deposition of dredged material. If material is not placed above the 5 year flood frequency level at a bottomland forest site, flood flows can enrich the sandy material and induce reestablishment of understory vegetation. However, if material is placed in a wetland, it is forever lost.

In addition, there are many dredging sites which are recurrent. This necessitates their being dredged at least once every 5 years, sometimes more (see Dredging Requirements Work Group-GREAT II Appendix). Due to the frequency of dredging, additional stress and habitat losses result in the vicinity of the dredge cut. Prime examples are losses which have occurred near Keithsburg (River Mile 525.5 to 526.6) and Fox Island (River Mile 354 to 356). At the recurrent sites the impacts of dredged material disposal could be reduced if the amount of material to be dredged could be reduced.

The FWMWG recommends that the Rock Island District evaluate all recurrent dredging sites to determine if training structures or other methods such as channel realignment, could reduce dredging in the area. Where beneficial, appropriate training structures should be repaired or constructed in accordance with FWMWG Recommendation #3007.

1. General problem addressed:

   (2) Fish and wildlife are affected by operation and maintenance practices associated with the nine-foot navigation project.

2. Sub-problem addressed:

   Placement of dredged material has frequently resulted in damage to fish and wildlife habitat. Many historic sites for dredged material disposal are filled to capacity and selection of new sites that will not impact habitat is difficult.

3. Sub-objective addressed:

Recommend and encourage the implementation of navigation project operation and maintenance programs and practices which preserve, restore or enhance fish and wildlife resources. Recommend the implementation of interagency fish and wildlife committee to coordinate programs and practices.

4. Tasks accomplished to address problem:

(2) Review historic and recent aerial photographs of GREAT II study area.
(9) Review literature to assess affects of the construction of the 9-foot navigation channel including its operation and maintenance on fish and wildlife
(14) Participate in selection of short- and long-term disposal sites.

5. Listing of alternatives to problem:

a. No action
b. The RID should evaluate all recurrent dredging sites to determine if training structures or other methods such as channel realignment could reduce dredging in the area. Where beneficial, appropriate training structures should be repaired or constructed in accordance with FWMWG Recommendation #3007.
c. Curtail all dredging in areas where disposal sites non-detrimental to fish and wildlife are unavailable.

6. Selected alternative: b

7. Rationale for selection of alternative:

Fish and wildlife habitat is lost from overfilling of past disposal areas or establishment of new sites, so measures to reduce amount of dredged material to be disposed of, will benefit preservation of such habitat.

8. References used to select alternative:

Tasks 2, 9 and 14.
Upper Mississippi River 9-foot Navigation Channel, Operations and Maintenance EIS.
Work Group Discussions
Dredge Disposal Task Force Discussion

9. Rationale for elimination of other alternatives:

a. Does not meet objective.
c. Does not maintain channel for navigation.

10. Preliminary impact assessment of selected alternative:

The evaluation of recurrent dredge sites will have no significant impacts. For an evaluation of repairing or construction of training structures, see FWMWG Recommendation #3007. Reduced dredging will have the following impacts:

Physical - Reduce dredging and resulting spoil disposal. Decrease erosion potential.
Habitat - Losses to backwater, wetland, and lowland hardwood habitats are minimized.
Fish - Protection of feeding and spawning habitat.
Wildlife - Protection of valuable wetlands. Eliminate disruption from recurrent spoil disposal. Protection of waterfowl nesting and feeding habitat.
Endangered Species - Negligible protection of Lampsilis higginsii habitat by decreasing erodible spoil material.
Other Resources - Some protection of benthos by decreasing erodible spoil material.
Water Quality - Beneficial by reduction in impacts of spoil disposal.
Air & Noise - Construction impacts reduced.
Energy - Dredging reduced.
Aesthetics - Reduction of large sterile spoil sites.
Management Areas - Beneficial, habitat protection
Recreation - Potential reduction in material available for beach nourishment. Reduction in excessively large disposal sites may make site more attractive for recreational use.
Economic - Cost of training structure vs. dredging operation. Administrative costs of evaluation.
Community - No impact.
Other Social - None.

The following impact assessment form is based on the fact that there are 29 recurrent dredge sites in the RID. It considers training structures only and not other methods to reduce dredging.

RECOMMENDATION #3008
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
SEE DREDGING REQUIREMENTS WORK GROUP RECOMMENDATION #4012 FOR DETAILED EVALUATION.					
Direct Cost of dredging and repairing structures	$	$600,000/year	$700,000/year	$2,600,000/year	+ $1,900,000/year
Indirect Protection of fish and wildlife habitat	acres	loss of habitat and additional habitat losses each year, average of 37 acres of habitat lost each year	continued losses of habitat at recurrent sites, approximately 37/acres/year	Minimize losses due to reduced dredge spoil disposal at recurrent dredge sites potential protection of approximately 37 acres of habitat/year	+ 37 acres/year
Enhancement of fish and wildlife habitat	quality of habitat	fish and wildlife not considered in design of training structures	fish and wildlife not considered in design of training structures	improved flow and substrate characteristics for each training structure to improve habitat	improved habitat

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3009

Pool No. All

River Mile District Wide

Date Approved by Work Group 3-3-80

As discussed in the text of this appendix, operation of the lock and dam system on the Upper Mississippi River (UMR) for navigation necessitates water level control in each of the pools. Water levels are evaluated on a daily basis by each of the the Corps of Engineers (COE) District offices on the river. Based on this evaluation lockmasters are given operating instructions for that day and a five-day forecast of operating conditions. Water level manipulations are done in an attempt to maintain a stable pool level for navigation. Normally, each lockmaster is given a leeway of 0.4 foot below and 0.1 foot above normal operating levels in achieving a stable pool level. During the winter, non-navigation months, the lockmasters have a one foot leeway in achieving a stable pool. This regulation is often complicated by influxes of precipitation in the watershed and drastic changes in the water levels of the pools.

A frequent complaint of sport and commercial fishermen and trappers on the river is the varying water levels. Often this occurs during relatively stable weather conditions. River biologists have observed regular oscillations in pool levels as well as drastic changes of up to five feet with no known corresponding natural event.

Unstable water levels adversely affect fish and wildlife of the river. These range from large changes which affect den building furbearers to slight changes of several inches which may cause spawning fish to abandon their nests. These fluctuations further stress backwater habitat that has already been severely stressed by siltation. Boater access and fishing patterns are also disturbed. Fluctuations in the winter months put severe stress on fish and wildlife resources already under habitat stresses. Entrapment of fish under ice has been observed as a result of these fluctuations.

Controlled water level changes could have a beneficial impact on fish and wildlife resources. Scheduled pool drawdowns can be used for moist soil management. A drawdown during the summer can expose mudflats which can be seeded. As the vegetation germinates and grows, the pool is gradually returned to normal. The reflooded vegetation will provide marginal fish habitat in the fall and serves as a substrate and nutrient source for phtoplankton and zooplankton. Increasing the density of the vegetation buffer zone bordering islands and sloughs will decrease wave induced erosion. Bird watching

opportunities will be enhanced as many avian species will be attracted to the area. In addition, there will be an increase in food available for waterfowl.

Documentation of the adverse effects of controlled water level changes has not been adequately undertaken. Further, the possibility of practicing moist soil management in the various pools of the Rock Island District (RID) has not been evaluated. Water level changes in each of the pools need to be documented with special attention paid to the critical periods of spring, late fall, and winter and the coordination among the COE districts. This information should be evaluated to determine the amount of control a lockmaster could have exercised over a particular situation. An additional evaluation should be made to determine potential locations for moist soil management.

The FWMWG recommends that the RID, in coordination with the federal and state resource agencies, assess the impact of controlled water level changes on fish and wildlife resources of each pool of the UMR and reevaluate District operating policies. The work group further recommends that the fish and wildlife interagency committee (FWIC) develop criteria using the District's assessment and evaluation. The District should adopt these criteria if they are acceptable to federal and state resource agencies. The criteria should protect and enhance fish and wildlife resources consistent with the mandate to maintain navigation.

1. General problem addressed:

   (2) Fish and wildlife are affected by operation and maintenance practices associated with the nine-foot navigation channel.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   (2) Recommend and encourage the implementation of navigation project operation and maintenance programs and practices which preserve, restore or enhance fish and wildlife resources.

4. Tasks accomplished to address problem:

   (1) Review existing literature concerning use of backwaters by fish and wildlife resources.
   (16) Review literature regarding manipulation of water levels to benefit fish and wildlife resources.
   (17) Plan to seed mudflats in Pool 16 exposed by water level manipulation.

5. Listing of alternatives to problem:

   a. The RID should assess the impact of controlled water level changes on fish and wildlife resources of each pool of the UMR and reevaluate District operating policies.

b. Using the COE's assessment and evaluation the FWIC should develop criteria for water level manipulation to protect and enhance fish and wildlife resources consistent with the mandate to maintain navigation.
c. The COE should adopt these criteria.
d. No action.
e. A,B, & C combined.

6. Selected alternative ___e___ .

7. Rationale for selection of alternative:

There is a need to evaluate the impacts of controlled pool level changes of fish and wildlife resources and to protect and enhance these resources whenever possible.

8. References used to select alternative:

FWMWG discussion
GREAT I Fish and Wildlife Work Group Draft Appendix
Literature Review
FWMWG pool level fluctuation study environmental assessment.

9. Rationale for elimination of other alternatives:

a. Does not provide criteria for management.
b. Does not provide an evaluation of impacts.
c. Is not applicable without alternatives a & b.
d. Does not meet objective.

10. Preliminary impact assessment of selected alternative:

Assessment of the impact of controlled water level fluctuations and development of criteria will not have any significant environmental impacts. Implementation of developed criteria will:

Physical - drastic controlled fluctuations of the water level in each pool will be avoided. Moist soil vegetation planting
Habitat - protection of habitat. Reduction is varying water levels. Potential enhancement with development of moist soil vegetation planting areas.
Fish - protection of fish wintering in backwaters, spawning fish, and fish fry. Potential creation of spawning and cover habitat through moist soil management.
Wildlife - protection of den building furbearers. Benefit to waterfowl through moist soil management.
Endangered Species - some reduction in stress from varying water levels.
Benthos & Other Resources - Some reduction in stress from varying water levels.
Water Quality - slight benefit from reduced erosion potential from fluctuating water level and maintenance of backwater water elevations.

Air & Noise - no impact.
Energy - no impact.
Aesthetics - no impact.
Management Areas - preservation of habitat.
Recreation - improved fishing and hunting through improved habitat.
Benefit to ice fishing by stabilizing water levels under ice.
F&W Commercial - benefit through improved habitat.
Economic - no impact.
Community - no impact.
Social - no impact

Recommendation #3009
Impact Assessment Form

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Administrative costs of evaluation	man-days $175/man-day/year	0 man-days ($0)	0 man-days ($)	230 man-days ($40,250)	+ $40,250
Impact study costs	$	$0	$0	$65,000	+ $65,000
Indirect Protection of fish and wildlife habitat	acres	unknown amount of acres impacted	continue impacts to habitat	unknown acres protected.	unknown acres protected
Enhancement of fish and wildlife habitat	acres	no acres enhanced	no acres enhanced	unknown potential for acres to be enhanced	unknown acres enhanced

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3010

Pool Number 13, 14, 17 & 18

River Mile See Below

Date Approved by Work Group 1-16-80

Several of the management areas in the study area utilize a system of levees to provide refuge to migrating waterfowl. From time to time these levees must be maintained and repaired to ensure the integrity of the levees. Material dredged during normal channel maintenance activities could be utilized in these instances. The material could be stockpiled at request within the management area for use and at a cost savings to the resource managers.

The FWMWG recommends that the Corps of Engineers-Rock Island District (RID) utilize dredge material to maintain, repair, or upgrade levees surrounding the following state and federal refuge and management areas:

1) Spring Lake-River Mile 531.7 to 534.6 LB-Upper Mississippi River Wild Life and Fish Complex
2) Green Island-River Mile 546.0 to 548.5 RB-Iowa Conservation Commission.
3) Princeton-River Mile 503.5 to 506.0 RB-Iowa Conservation Commission
4) Odessa-River Mile 435 RB-Iowa Conservation Commission
5) Keithsburg-RM 428 to 431 LB-Mark Twain National Wildlife Refuge

1. General problem addressed;

   (2) Fish and wildlife are affected by O&M practices associated with the 9-foot navigation project.

2. Sub-problem addressed; N/A

3. Sub-objective addressed:

   Recommend and encourage the implementation of navigation project O&M programs and practices which preserve, restore or enhance fish and wildlife resources.

4. Tasks accomplished to address problem:

   Participate in the selection of short and long-term dredge disposal sites.

5. Listing of alternatives to problem:

   a. Utilize dredge material to upgrade levees surrounding state and federal refuge and management areas
      1) Spring Lake 531.7 to 534.6 LB

2) Green Island 546 to 548.5 RB
3) Princeton 503.5 to 506 RB
4) Odessa 435 RB
5) Keithsburg 428 to 431 LB

b. No action.

6. Selected alternative: a

7. Rationale for selection of alternative:

Provides an alternative to disposal on fish and wildlife habitat without additional habitat destruction.

8. References used to select alternative:

FWMWG Discussion

9. Rationale for elimination of other alternatives:

b. will continue loss of habitat.

10. Preliminary impact assessment of selected alternative:

Placement of the dredged material will not have any significant environmental impacts at these sites. There will be localized loss of habitat at each disposal site, but these impacts will be temporary since the material will be quickly used. Each management area should be required to revegetate each disposal site after the material is used.

The material will be used to bring existing levees up to specifications. It will improve levee integrity and be beneficial to wildlife in establishment of wildlife crops by water level manipulation and limited flood control.

RECOMMENDATION #3010
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
	THESE SITES ARE INCLUDED IN THE GREAT II CHANNEL MAINTENANCE PLAN (CMP)				
	SEE PLAN FORMULATION WORK GROUP APPENDIX FOR COMPLETE ASSESSMENT.				
Direct Dredging costs	$	Disposal may occur at these sites. No containment	Disposal may occur at these sites. No containment	Included in CMP. Containment required.	+ cost of containment
Levee repair and maintenance costs	$	Sites need maintenance	Cost of material and transport borne by management agencies	Cost borne by COE-Channel Maintenance Plan	Cost savings to management agencies No additional cost to COE
Indirect Improved management of areas set aside for fish and wildlife	habitat quality	Maintenance needed to meet management objectives	Maintenance needed to meet management objectives	Improved habitat through management activities	Improved habitat quality
Improved waterfowl hunting	waterfowl hunting quality	Hunting quality affected by management capabilities	Status quo	Some improvement through maintenance	Some improved hunter quality

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3040

Pool Number All

River Mile (Attachment)

Date Approved by Work Group 3/21/80

In addition to the backwater areas discussed in FWMWG 3035, the Side Channel Work Group, GREAT II, as well as the public, has identified many backwater areas which are in critical need of remedial action due to operation of the navigation channel (i.e. dredged material disposal, regulatory structures, etc.). It has been estimated by various authors that backwater lakes, ponds and sloughs will be completely converted to terrestrial vegetation within 100 years (Ekblad, 1977; GREAT I Sediment and Erosion Work Group, 1979; Bellrose, et. al, 1977). In a riverine system that has been altered and controlled by man, the quality of fish and wildlife habitat must also be artificially maintained.

The SCWG II developed criteria to evaluate backwater areas in critical need of remedial action to preserve or restore valuable habitat (see SCWG II recommendation 3504). Of the 48 sites given highest priority for remedial action, the operation and maintenance of the navigation channel is a primary cause for habitat losses at 21 sites. Currently, the RID has authority to mitigate these losses. However, studies are necessary to determine the appropriate methods/solutions.

The FWMWG recommends that as soon as possible the RID determine specific methods to improve flow and decrease sedimentation at the attached list of backwater and side channel areas. The RID should give priority over other backwater areas to these sites and those listed in FWMWG 3035 in any decision to implement a remedial aciton.

1. General problem addressed:

   (2) Fish and wildlife are affected by operation and maintenance practices associated with the 9-foot navigation process.

2. Sub-problem addressed:

   Turbidity and sedimentation may accentuate losses of fish and wildlife habitat that were caused initiatally by O&M practices.

3. Sub-objective addressed:

   (2) Recommend and encourage the implementation of navigation project operation and maintenance programs and practices which preserve, restore and enhance fish and wildlife resources.

(4) Identify and discuss alteration methods and measures which will improve habitat in off-channel areas.

4. Tasks accomplished to address problem:

(1) Review existing literature concerning use of backwaters by fish and wildlife resources. (2) Review historic and recent aerial photographs of GREAT II study area. (3) Review GREAT I SECWG report (5) Review GREAT I and II SCWG reports (9) Review literature to assess affects of construction of the 9-foot navigation channel including its operating and maintenance on fish and wildlife.

5. Listing of alternatives to problem:

a. The FWMWG recommends that as soon as possible the RID determine specific methods to improve flow and decrease sedimentation at the attached list of backwater and side channel areas. The RID should give priority over other backwater areas to these sites and those listed in FWMWG 3035 in any decision to implement a remedial action.
b. Also include SCWG Priority 2 sites in alternative a.
c. No action.

6. Selected alternative: a

7. Rationale for selection of alternative:

Dredge spoil disposal and navigation structures have limited flow in many backwater areas so that the sedimentation rate in these areas has increased. If allowed to continue, valuable aquatic habitat will succeed to bottomland forests in the near future.

8. References used to select alternative:

SCWG II Draft Appendix
FWMWG Discussion

9. Rationale for elimination of other alternatives:

b. Priority 2 sites are not in immediate danger of great habitat losses. All attention and planning should focus on the listed Priority 1 sites.
c. Will not preserve valuable habitat.

10. Preliminary impact assessment of selected alternative:

Studying potential methods for remedial action will not have any significant impacts. Site specific analysis for each alteration will be necessary. Altering backwaters and navigation structures will have impacts similar to those described in FWMWG 3007 and 3027.

RECOMMENDATION #3040
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
See Recommendation Impact Assessment Form for FWMWG 3035. (p. 115)					

SCWG Priority 1A Sites

Sites which have lost considerable habitat value due to operation and maintenance of the navigation channel. These sites will continue to loose habitat value at a rapid rate. Remedial action is required immediately if the area is to be preserved.

Pool	Site	River Mile
11	Dam 10	615.1 L
	Cassville Slough	614.9 L
	Goetz Island	613.2 R
	Bunker Chute	603.3 R
	Hurricane Island and Chute	592.0-598.5 L
	Dam 11/Highway 61	583.1 L
12	No Sites in 1A Category	
13	Dam 12	556.7 L
14	Dam 13	522.5 R
15	No Sites in 1A Category	
16	No Sites in 1A Category	
17	Blanchard Island	449.0 L
18	Unnamed	429.2-430.8 R
	Kingston Bar	424 R
19	Otter Slough	407-409 R
	Otter Island	408.5 R
	Rush/Baby Rush Islands	406.2 R
20	Taylor Chute	353 L
	Huff/Hunt Islands	349-350 L
21	Teal Island	332.5 L
	Broad Lake/Quincy Bay	328.0-329.3 L
22	Texas Chute	324.0 L
	Beebe Island	316.7-318.5 L
	Unnamed	316.0 L
23 (22 Tailwaters)	Cottel Island	300-301 L

VIII. B. 3. Problem 3

Information on the distribution and abundance of fish and wildlife resources is inadequate for management decision.

FWMWG 3013

The FWMWG recommends that pending completion of Stages 1 and 2 of the submergent characteristics study, State 3 should be undertaken. Upon completion of Stage 3, data should be incorporated into the ongoing GIS study to ascertain its value in identifying fish habitat. Stage 4 should be undertaken if results of State 3 warrants further action.

FWMWG 3026

The FWMWG recommends that information on the distribution, abundance, population characteristics, and harvest of all fish and wildlife species in the UMR should be collected and periodically updated on a systematic basis. The effort should be coordinated by the UMRCC, with funding provided by the Upper Mississippi River Basin Commission (UMRBC) for state and federal participation.

FWMWG 3024

The FWMWG recommends that funding and manpower should be made available by the U.S. Congress to the U.S. FWS and state resource agencies to complete the GIS throughout the UMR corridor. The U.S. FWS should act as the central depository for this information and should update the GIS as new information is collected under this problem and other sources. The U.S. FWS should ensure that the GIS is readily accessible by all resource managers.

FWMWG 3014

The FWMWG recommends that the USFWS locate, map, and annually monitor colonial bird nesting sites. Additionally the FWS in coordination with the state and resource agencies should develop information on distribution, abundance, and population characteristics of colonial birds nesting in the study area. Once this is done, the information should be incorporated into the GIS.

FWMWG 3025

The FWMWG recommends that the State of Iowa should continue the wing dam study to ascertain relationships between biological and physical parameters of various types of wing dams. Further, they should develop recommendations for the construction/repair of wing dams in a manner which optimizes fish and wildlife habitat without detracting from their intended purpose.

FWMWG 3031

The FWMWG recommends that a program should be established to monitor federal and state endangered or threatened species to obtain information on distribution, abundance, and population character-

istics. Particular emphasis should be placed on present habitat utilization within the UMR floodplain so that habitat management techniques may be developed for the species. This program should be coordinated by the U.S. Fish and Wildlife Service in conjunction with the state resource agencies. If necessary, additional funding should be sought by the U.S. Fish and Wildlife Service.

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3013

Pool Number All

River Mile District-wide

Date Approved by Work Group 1/16/80

The GREAT I Fish and Wildlife Work Group (FWWG) contracted a comprehensive inventory of the submergent, emergent, and terrestrial vegetation of the UMR from the Twin Cities to the Ohio River through the use of aerial photography. The study depicts the emergent and terrestrial vegetation of the river corridor, but was not able to provide an inventory of submergent characteristics.

Habitat for fish on the UMR is extensive. A method which readily quantifies submergent characteristics and thus suitable habitat for various species of fish is necessary to develop a river management plan. In addition information on depth, bottom types and submerged physical features would be beneficial in development of a river management plan. To accomplish this project, a four stage study has been initiated by the FWMWG.

Stage 1 - Methodology and equipment review and evaluation.
Stage 2 - Develop a study plan for a pilot project using Stage 1 approved methodologies.
Stage 3 - Implementation of pilot project (Pool 13).
Stage 4 - Develop a study plan for future implementation on the entire UMR.

A portion of Stages 1 and 2 was accomplished as a contract of the FWMWG. However, the work group decided additional technical methods had to be evaluated. GREAT II did not have the funds or time to see this project to completion. Therefore, Stages 1 and 2 need additional investigation. Using findings of Stages 1 and 2, Stage 3, a field test of the methodologies, is necessary to fill this data gap. Pending results of Stage 3, Stage 4 should be performed to prepare a study plan for further data collection and incorporation into the Geographic Information System (GIS) (FWMWG 3024).

The FWMWG recommends that pending completion of Stages 1 and 2 of the submergent characteristics study, Stage 3 should be undertaken. Upon completion of Stage 3, data should be incorporated into the ongoing GIS study to ascertain its value in identifying fish habitat. Stage 4 should be undertaken if results of Stage 3 warrants further action.

1. General problem addressed:

   (3) Information on distribution and abundance of fish and wildlife resources is inadequate for many management decisions.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

Conduct and recommend studies to fill voids in our knowledge of fish distribution and abundance.

4. Tasks accomplished to address problem:

13. Study to assess capability of obtaining submergent characteristics of the UMR.

5. Listing of alternatives to problem:

   a. Pending completion of Stages 1 and 2 of the submergent characteristics study, Stage 3 should be undertaken. Upon completion of Stage 3, data should be incorporated into the ongoing GIS study to ascertain its value in identifying fish habitat. Stage 4 should be undertaken if results of Stage 3 warrants further action.

   b. Complete Stage 1 and 2 and terminate study.

   c. Complete total study but do not incorporate results in the GIS.

6. Selected alternative ___a___.

7. Rationale for selection of alternative:

Mapping the distribution of submerged aquatic vegetation, invertebrates, bottom types and depths and submerged physical features of the river would be beneficial in making resource management decisions. This would supplement the existing GREAT I mapping of emergent and terrestrial vegetation.

8. References used to select alternative:

FWMWG Submergent Characteristics Study Scope of Work
GREAT I FWWG Pilot Study
FWMWG discussion
UMRBC resolution of submerged data of the UMR
Hazelton Evaluation of Physical Information Gathering Methods for the Upper Mississippi River.

9. Rationale for elimination of other alternatives:

   b. May provide a viable act if results of Stage 1 does not provide the "green light" for further work.
   b. The additional steps of digitizing, encoding data and developing suitability models must be completed to evaluate the effectiveness of the exercise. Additional work should not be pursued until this evaluation is complete.

10. Preliminary impact assessment of selected alternative:

Implementation of this study will not have any significant environmental impacts. Collection of this information by implementation of a plan (see FWMWG 3024) devised in Stage 4 will have impacts similar to those described in FWMWG 3026.

RECOMMENDATION #3013
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Stage 3 and 4 study costs	$	No funding	unlikely study will be completed due to limited funds and study priorities	Approximately $125,000 depending on technologies used.	$125,000
Indirect Protection of fish and wildlife habitat	acres	submergent characteristics of 140,500 acres of aquatic habitat relatively unknown	piecemeal data collection. Little additional information available for improved habitat decisions.	Improved data base for habitat management and alteration decisions	increase in acres of habitat protected.

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3026

Pool Number All

River Mile District-Wide

Date Approved by Work Group 1-16-80

A considerable wealth of information is available on the distribution, abundance, population characteristics, and harvest of many fish and wildlife resources of the Upper Mississippi River. The value of much of that information for use in modern management decision making processes is greatly limited, however, for various reasons. With an ever-changing river environment, information previously collected on the distribution, abundance, population characteristics, and harvest of fish and wildlife resources may not be applicable to present conditions. Much of the information available concentrates on a relatively few species of significant sport or commercial value. Nearly all of the information is collected for specific sites or areas. The ability to integrate information and apply it to the biological system as a whole is severely limited by incongruities in sampling methods or data analysis, and the intermittent nature and seasonal differences in data collection.

To acquire the needed biological information base for current management decisions, additional data is needed on the distribution, abundance, population characteristics, and harvest of many species important to the river's biological system as a whole. Voids exist in the knowledge available on major species which have been studied. Many more species, important as forage, indicators, or non-game species, have not been studied at all.

This type of baseline information, as well as studies to up-date the current data base, must be collected on a systematic and coordinated basis to permit integration and expansion of the data over the river as a whole. A delineation of data needs and specific sampling objectives is necessary for the river system. Certain standardization of sampling gear between agencies has been accomplished through the Upper Mississippi River Conservation Committee. But additional standardization of methods, data analysis, sampling frequency, and timing is also needed to make data comparable.

The UMRCC is a logical vehicle to coordinate these tasks. Proposals are currently being formed by the UMRCC, for funding under the Master Plan, which would provide certain long-term indications of population trends through a coordinated sampling of index sites. With additional funding through the UMRBC, this coordinated effort could be expanded to provide the distribution, abundance, population characteristics, and harvest information which is needed to make sound fish and wildlife management decisions. This information can be incorporated into the Geographic Information System (FWMWG #3024) and will be readily available to UMR biologists.

The FWMWG recommends that information on the distribution, abundance, population characteristics, and harvest of all fish and wildlife species in the UMR should be collected and periodically updated on a systematic basis. The effort should be coordinated by the UMRCC, with funding provided the Upper Mississippi River Basin Commission (UMRBC) for state and federal participation.

1. General problem addres

   (3) Information on the u..stribution and abundance of fish and wildlife resources is inadequate for many management decisions.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   Identify voids in our present knowledge of the distribution and abundance of fish and wildlife resources on the Upper Mississippi River. Conduct and recommend studies to satisfy areas noted above.

4. Tasks accomplished to address problem:

   Literature search and review. Studies on the use of the main channel by fishes, the effect of notching wing dams, classifying wing dams to determine beneficial characteristics for fish and identifying and mapping submergent habitat characteristics.

5. Listing of alternatives to problem:

   a. Information on the distribution, abundance, population characteristics, and harvest of all fish and wildlife species in the UMR should be collected and periodically updated on a systematic basis. The effort should be coordinated by the UMRCC, with funding provided thru the UMRBC for state and federal participation.
   b. Continue current investigations and surveys conducted independently by each agency on major species of commercial or sport importance as agency funding permits.

6. Selected alternative: a

7. Rationale for selection of alternative:

   Data of this type gained on the total fish and wildlife communities on a coordinated, systematic basis would provide the information needed to make sound management decisions and develop a river management plan.

8. References used to select alternative:

   FWMWG Discussion
   UMRCC Technical Committees Discussion

GREAT II Fish and Wildlife Management Work Group Annotated Bibliography. Volume I, II and Addendum. Hazelton Environmental Sciences Corp. 1979. 1096pp.
Rasmussen, J.L. 1979. A Compendium of Fishery Information on the Mississippi River. Second Edition. 259pp.

9. Rationale for elimination of other alternatives:

The interaction of forage and non-game fish and wildlife species with commercial and sport species is not adequately addressed under alternative b. The value of these other species to the river's biological system must be understood before any management decisions can be made. Alternative b would not permit complete integration of information.

10. Preliminary impact assessment of selected alternative:

Collection of information will:

Physical - No direct impacts.
Habitat - Improved knowledge and understanding of fish and wildlife habitat utilization.
Fish - Improve understanding of total fishery community, their status, and utilization.
Wildlife - Improve understanding of total wildlife community, their status, and utilization.
Endangered Species - See FWMWG Recommendation #3031.
Benthos - Improved understanding of relation of benthos resources to fish and wildlife.
Water Quality - Improved understanding of relation of water quality parameters to fish and wildlife life requirements.
Air & Noise - Air and noise impacts on fish and wildlife life requirements will be a minor portion of the information collection.
Energy - Minor use in collection of information
Aesthetics - No direct impact.
Management Areas - Increase information available for management decisions.
Recreation - No direct impact. Potential for improved hunting and sportfishing through wise management decisions.
F&W Commercial - No direct impact. Potential for improved trapping and commercial fishing through wise management decisions.
Economic - Increased expenditures for fish and wildlife investigations.
Community - Improved inter-agency coordination commonality of goals and management objectives. Reduce unnecessary duplication of effort between agencies.
Social - No direct impacts.

RECOMMENDATION #3026
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Development of monitoring plan	$	$0	plan developed by UMRCC. Costs borne by states	$67,000 borne by federal government	+ $67,000
Testing of monitoring systems	$	$0	unknown	costs variable; dependent on number of test sites, equipment needs, and variables to be tested	unknown
Costs of a monitoring program	$	each state does some data collection	Additional piecemeal data collection	$615,000 - $1 million annually for long-term monitoring (contingent on completion of planned Master Plan Studies)	+ $615,000 - $1 million annually
Indirect Improved habitat through improved understanding of resource requirements	habitat quality	Information often lacking. Degradation of habitat quality	Status quo.	Improved management decisions	Improved habitat quality

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3024

Pool No. All

River Miles District Wide

Date Approved by Work Group 1-16-80

Some of the difficulties in management of the fish and wildlife resources of the Upper Mississippi River (UMR) arise from the fact that specific information on a particular site is not readily available. GREAT I Fish and Wildlife Work Group (FWWG) contracted a study to design a system for compiling habitat and resource information. This study resulted in the UMR Geographic Information System (GIS) and a successful pilot study. However, the GIS now lacks a method for evaluation of submergent characteristics (see FWMWG 3013).

In October 1978, GREAT and the U.S. Fish and Wildlife Service (USFWS) contracted to utilize the GIS for the GREAT I study area. It will be used mainly in development of the master plan for the UMR Wild Life and Fish Refuge. To provide a complete resource management tool for the UMR, the GIS needs to be implemented for the entire UMR.

The FWMWG recommends that funding and manpower should be made available by the U.S. Congress to the USFWS and state resource agencies to complete the GIS throughout the UMR corridor. The USFWS should act as the central depository for this information and should update the GIS as new information is collected under this problem and other sources. The USFWS should ensure that the GIS is readily accessible by all resource managers.

1. General problem addressed:

   (3) Information on distribution and abundance of fish and wildlife resources is inadequate for many management decisions.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   Conduct and recommend studies to fill voids in our knowledge of fish distribution and abundance.

4. Tasks accomplished to address problem:

   Literature search and review. Study use of main channel by fish. Study to assess capability of obtaining submergent characteristics of the UMR.

5. Listing of alternatives to problem:

   a. Funding and manpower should be made available by the U.S. Congress to the USFWS and state resource agencies to complete the GIS throughout the UMR corridor. The USFWS should act as the central depository for this information and should update the GIS as new information is collected under this problem and other sources. The USFWS should ensure that the GIS is readily accessible by all resource managers.
   b. No action

6. Selectd alternative __a__ .

7. Rationale for selection of alternative:

   The GIS will provide an effective and functional resource management tool on the UMR.

8. References used to select alternative:

   FWMWG discussion
   FWMWG Submergent Characteristics Study
   GREAT I FWMWG Pilot GIS Study
   USFWS GIS for UMR Wild Life and Fish Refuge Complex

9. Rationale for elimination of other alternatives:

   (b) Will not provide the desired information.

10. Preliminary impact assessment of selected alternative.

    Instituting the GIS on the UMR will not have any significant environmental impacts. The impacts of data collection are discussed under FWMWG 3009, 3013, 3014, 3025, 3026 and 3031. Completion of the GIS will require a commitment of the USFWS and the state resource agencies of personnel and funds. Use of the GIS will improve our knowledge and understanding of fish and wildlife resources of the UMR as a whole and will result in improved management decisions in the preservation, protection, and enhancement of natural habitat.

RECOMMENDATION #3024
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Cost of completion	$	GIS instituted for Pools 11-14 @$570/mile*= $69,540	No planned institution of GIS for rest of pools	Miles @ $570/mile = $109,440	+$109,440
Cost of update	$	Not planned	Not specifically planned	Update every five years $178,980/5 years*	$178,980/5 years*
Indirect Habitat protection	habitat	Information on Pools 11-14 available for management decisions	No habitat information available for Pools 15-22	Completion of GIS for all pools. Improved management and protection decisions	Improved habitat quality

* Does not include costs of including submergent characteristics. See FWMWG 3013.

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3014

Pool Number 3014

River Mile District-wide

Date Approved by Work Group 1/16/80

Populations of colonial birds nesting in the study area have been declining. (See Section III C.2. this Appendix) Monitoring of these species has been sporadic which has made management and identification of specific adverse effects causing the decline difficult. Without basic information such as nesting and feeding sites, protection and management of these species is difficult. Improved data will aid in identifying impacts of industrialization, dredge spoil disposal, navigation, and recreation. The U.S. Fish and Wildlife Service (FWS) should serve as the central depository for this information.

The FWMWG recommends that the U.S. FWS locate, map and annually monitor colonial bird nesting sites. Additionally, the FWS in coordination with the state resource agencies should develop information on distribution, abundance, and population characteristics of colonial birds nesting in the study area. Once this is done, the information obtained should be incorporated into the GIS.

1. General problem addressed:

   (3) Information on distribution and abundance of fish and wildlife resources is inadequate for many management decisions.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   Identify voids in our present knowledge of distribution and abundance of fish and wildlife resources on UMR. Identify the extent of area and habitat which has been usurped by industrial, agricultural, or municipal development. Identify detrimental effects of recreational and commercial traffic on fish and wildlife resources.

4. Tasks accomplished to address problem:

   Compile all existing published and unpublished data relating to fish and wildlife of UMR. Identify information gaps in existing literature. Document impacts on fish and wildlife resources.

5. Listing of alternatives to problem:

   a. The U.S. Fish and Wildlife Service locate, map, and annually monitor colonial bird nesting sites. Additionally, the FWS

in coordination with the state resource agencies should develop information on distribution, abundance, and population characteristics of colonial birds nesting in the study area. Once this is done, the information obtained should be incorporated into the GIS.

6. Selected alternative: a

7. Rationale for selection of alternative:

Monitoring of colonial bird nesting sites will provide better data to make management decisions and will serve as a method to identify impacts of industrial, dredge spoil, recreation, and environmental contaminents. Without updated information, resource agencies will be unable to determine the status of colonial nesting birds.

8. References used to select alternative:

Thompson, D.H. 1977. Declines in Populations of Colonial Water Birds Nesting Within the Floodplain of the Upper Mississippi River. Proc. Colon. Waterbird Group Conf., DeKalb, IL 16pp.
Thompson, D.H. 1978. Identification of Critical Habitat and Causes of Population Declines in Great Blue Herons and Great Egrets Along the Upper Mississippi River. Draft Rept., 27pp.

9. Rationale for elimination of other alternative:

No action will not provide the necessary information.

10. Preliminary impact assessment of selected alternative:

Monitoring will aid in the protection of colonial bird habitat. There will not be any other significant impacts. Protection of these species may induce more environmentally acceptable alternatives for industrial development, dredge spoil disposal, navigation or recreation to be sought.

RECOMMENDATION #3014
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Administrative costs of monitoring	man-days/year ($175/man-day/year)	5 man-days/year ($875/year)	5 man-days/year ($875/year)	30 man-days/year ($5250/year)	25 man-days/year ($4425/year)
Indirect Protection of nesting sites	# of rookeries	approximately 40 known rookeries on UMR	20 or less (Based on 50% decline or more)	protection of at least 40 sites possible establishment of new colonies.	protection of at least 20sites

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3025

Pool Number All

River Mile District-Wide

Date Approved by Work Group 1-16-80

The loss, manipulation, and degradation of aquatic habitats, since the construction of locks and dams, has resulted in a need to assess the importance of various riverine habitats and their use to fish populations. The main channel border habitat, including all areas in which wing dams occur, is considered excellent habitat for a variety of fish species (Fremling, 1973). Wing dams have been continuously subject to a variety of impacts; including alteration and modification, siltation, and some covered with dredge spoil. The impact of these habitat alterations on fish populations is unknown and should be evaluated.

The FWMWG recommends that the State of Iowa should continue the wing dam study to ascertain relationships between biological and physical parameters of various types of wing dams. Further, they should develop recommendations for the construction/repair of wing dams in a manner which optimizes fish and wildlife habitat without detracting from their intended purpose.

1. General problem addressed:

   (3) Information on the distribution and abundance of fish and wildlife resources is inadequate for management decisions.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   Recommend and encourage the implementation of navigation project operation and maintenance programs and practices which preserve, restore or enhance fish and wildlife resources. Conduct and recommend studies to fill informational voids in our knowledge of fish and wildlife distribution.

4. Tasks accomplished to address problem:

   Classify wing dams according to physical and hydrological features. Study the effect of notching wing dams on aquatic organisms.

5. Listing of alternatives to problem:

   a. No action.

b. State of Iowa should continue the wing dam study to determine the biological and physical relationships of various wing dam types. Further, they should develop recommendations for the construction/repair of wing dams in a manner which optimizes fish and wildlife habitat without detracting from their intended purpose.

6. Selected alternative: b

7. Rationale for selection of alternative:

Wing dams have continuously been subject to a variety of impacts; including alteration and modification, siltation, and covering with dredge spoil. The impact of these habitat alterations on fish populations is unknown and should be evaluated. As discussed in FWMWG #3007, training structures if properly designed, may be beneficial to fish and wildlife habitat.

8. References used to select alternative:

FWMWG Discussion
GREAT II FWMWG Wing Dam Notching Study (in progress)
GREAT II FWMWG Wing Dam Classification Study (in progress)
FWMWG I Draft Appendix

9. Rationale for elimination of other alternatives:

a. will not meet the objective.

10. Preliminary impact assessment of selected alternative:

The study will not have any significant impacts. However, structural modifications to wing dams which may be recommended are likely to have the impacts described in FWMWG Recommendation #3007.

The following impact assessment form evaluates the impacts of the Iowa Conservation Commission in completing the study.

RECOMMENDATION #3025
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Biological study costs	$	$0 spent by Iowa Conservation Commission for this study	$144,00 Funding by Iowa Conservation Commission and National Marine Fisheries Service.	$144,000 to complete study	+$ 0
Indirect Protection of fish and wildlife habitat	Acres	Unknown acres impacted by training structures	Additional impacts of training structures and potential loss of habitat	Improved planning and design to protect habitat	Unknown acres protected
Enhancement of fish and wildlife resources	habitat quality	Fish and wildlife benefits only given little or no consideration	Fish and wildlife given only secondary consideration	Improved habitat through improved substrate and flow characteristics	Improved habitat quality, in particular fishery habitat

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3031

Pool Number All

River Mile District-Wide

Date Approved by Work Group 3-3-80

The U.S. and all UMR state governments have legislation and programs to protect species whose existence is endangered or threatened. Biologists have recognized the need to protect and preserve these species when making habitat management decisions. Unfortunately, the very status of the species means that there is often very little information available on their distribution, abundance and population characteristics.

In this regard, the U.S. Fish and Wildlife Service has established two Recovery Teams (bald eagle and Higgins eye pearly mussel) to develop management techniques and recovery plans for these species. The Recovery Teams are comprised of noted experts on the species and selected field biologists. In order for the UMR biologists to make habitat management decisions, Recovery Teams need to be established for all federal endangered and threatened species on the UMR. Further, these Teams should be established for all state endangered species through their cooperative agreements with the U.S. Fish and Wildlife Service. After recovery plans are completed, a regular monitoring program should be conducted to evaluate the status of these species and the effectiveness of management techniques.

The FWMWG recommends that a program should be established to monitor federal and state endangered or threatened species to obtain information on distribution, abundance, and population characteristics. Particular emphasis should be placed on present habitat utilization within the UMR floodplain so that habitat management techniques may be developed for the species. This program should be coordinated by the U.S. Fish and Wildlife Service in conjunction with the state resource agencies. If necessary, additional funding should be sought by the U.S. Fish and Wildlife Service.

1. General problem addressed:

   (3) Information on the distribution and abundance of fish and wildlife is inadequate for many management objectives.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   (3) Identify voids in our present knowledge of the distribution and abundance of fish and wildlife resources on the UMR. Conduct and recommend studies to fill voids in our knowledge of fish and wildlife distribution.

4. Tasks accomplished to address problem:

   (8) Literature Review

5. Listing of alternatives to problem:

   a. A program should be established to monitor federal and state endangered or threatened species to obtain information on distribution, abundance, and population characteristics. Particular emphasis should be placed on present habitat utilization within the UMR floodplain so that habitat management techniques may be developed for the species. This program should be coordinated by the U.S. Fish and Wildlife Service in conjunction with the state resource agencies. If necessary, additional funding should be sought by the U.S. Fish and Wildlife Service.
   b. No action.

6. Selected alternative: a

7. Rationale for selection of alternative:

   In order to protect and preserve state and federal endangered species more information is needed on these species. This information would be invaluable in making habitat management decisions.

8. References used to select alternative:

   FWMWG Discussion
   Endangered Species Act of 1973, as amended.

9. Rationale for elimination of other alternatives:

   b. Does not meet objective.

10. Preliminary impact assessment of selected alternative:

   Monitoring will aid in the protection of threatened and endangered species. There will not be any other significant impacts. Protection of these species may induce more environmentally acceptable alternatives for industrial development, dredge spoil disposal, navigation, or recreation to be sought.

RECOMMENDATION #3031
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Costs of federal recovery teams	$ ($3000/ Team/year)	2 teams established ($6000/ year)	teams for all listed species will be established	same	no change
Cost of state recovery teams	$ ($2000/ Team/year)	$0	minimal investigation	43 teams established for state endangered species ($86,000)	+ $86,000
Indirect Protection of fish and wildlife resources	species	decline for the majority of species	continued decline for the majority of species	50 species protected from extinction or extirpation	48 additional species protected

VIII. B. 4. Problem 4

There is a lack of ability to predict the response of fish and wildlife to certain alterations of the river environment.

FWMWG 3029

The FWMWG recommends that the RID should document the cumulative impacts of modifications and encroachments to fish and wildlife habitats of the Upper Mississippi River (UMR) corridor.

FWMWG 3027

The FWMWG recommends the Rock Island District-Corps of Engineers complete the dredging and habitat development project and monitoring program described in the Technical Report for the Fulton Local Flood Protection Project-Stage IIIC.

FWMWG 3030

The FWMWG recommends that the UMRCC develop a plan for the RID to monitor all short-term disposal sites to document the impacts dredge spoil disposal on fish and wildlife resources. The RID should implement the plan and make the results available to the UMRCC and federal and state resource agencies in order that they may evaluate the short-term disposal plan.

FISH AND WILDLFIE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3029

Pool No. All

River Mile District Wide

Date Approved by Work Group 3-3-80

The U.S. Army Corps of Engineers (COE) has the responsibility for regulating certain activities in the Mississippi River. These include the construction of such things as boat docks, piers, boat harbors, levees, and bank protection. The number of permit application for these proposed projects is increasing every year.

Environmental impacts resulting from major projects such as barge terminals or boat harbors are usually closely scrutinized because of the obvious impacts that may occur to fish and wildlife. Less apparent are the cumulative impacts of many smaller projects. The fact that in the 314 miles of river in the Rock Island District (RID), there are approximately 450 miles of agricultural levee, 52 miles of riprap, and 178 miles of wing dams illustrates these cumulative aspects.

The extent to which these cumulative impacts are occurring, whether *detrimental* or beneficial, is poorly documented. There is a definite need to document what effect these impacts have on the various fish and wildlife habitats. In addition, the COE regulatory program, as set forth in 33 CFR 320-329, instructs them to consider cumulative impacts when granting permits.

The FWMWG recommends that the RID should document the cumulative impacts of modifications and encroachments to fish and wildlife habitats of the Upper Mississippi River (UMR) corridor.

1. General problem addressed:

   (4) There is a lack of ability to predict the response of fish and wildlife resources to certain alterations of the river environment.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   (3) Identify voids in our present knowledge of the distribution and abundance of fish and wildlife resources of the UMR.
   (5) Recommend actions to reduce impacts of encroachment.

4. Tasks accomplished to address problem:

(8) Literature Review

5. Listing of alternatives to problem:

a. The RID should document the cumulative impacts of modifications and encroachments to fish and wildlife habitats of the UMR corridor.
b. No documentation.

6. Selected alternative: a.

7. Rationale for selection of alternative:

Many habitat alterations or encroachments cause little apparent damage to fish and wildlife resources. However, when viewed cumulatively, losses from these activities are substantial.

8. References used to select alternative:

FWMWG discussion
Fisheries, Vol. 4, No. 2, pp. 55-57

9. Rationale for elimination of other alternatives:

b. Does not meet objective.

10. Preliminary impact assessment of selected alternative:

Collection of information will have impacts similiar to those described in FWMWG 3026.

RECOMMENDATION #3029
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct					
		DATA AND INFORMATION OBTAINED IN FWMWG RECOMMENDATIONS 3014, 3023, 3024, 3026, 3030, 3031, 3032, 3033, and 3034 WILL INPUT INTO THIS RECOMMENDATION			
Additional study costs	$	Unknown piecemeal studies	Unknown piecemeal studies	From $2,450,000 to $4,000,000 in additional studies	+ $2,450,000 to $4,000,000
Indirect Better decision making regarding habitat alterations and impacts	habitat quality	Little or no consideration given to cumulative impacts	Status quo	Improved planning and decision making	Improved habitat quality
Protection of fish and wildlife resources	acres	Unknown acres impacted on cumulative basis	Continuation of unidentified cumulative impacts	Lessen acres loss to cumulative impacts	Preservation of unknown acres of habitat

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3027

Pool Number 14

River Mile 516 to 517.9

Date Approved by Work Group 1-16-80

FWMWG Recommendation #3006 recommends that backwater modifications be accomplished to preserve fish and wildlife habitat. However, potential dredging of the backwaters will require the disposal of significant amounts of silty material. Unless agricultural disposal is shown to be feasible, it is likely most disposal would occur in areas of basically monotypic lowland hardwood habitat.

Unlike sand spoil, it is thought that silt spoil may provide opportunities for enhancing lowland hardwood habitat. The Rock Island District and the U.S. Fish and Wildlife Service in cooperation with the Illinois Department of Conservation and the U.S. Soil Conservation Service have developed a plan to evaluate habitat development on silt material in conjunction with the Fulton Local Flood Protection Project. This plan will evaluate silt tolerance and growing success of tree, shrub, vine, grass, and shrub species that are beneficial to wildlife. Additional information will be sought to determine the relative effect of varying disposal depths.

In the past, several backwater modifications associated with flood control or highway projects have been recommended by UMR biologists. However, benefits to fishery resources have not been well documented. This proposal recommends that fishery data be collected before and after the dredging operation begins to identify the impacts of backwater modification. The terrestrial habitat development will also be monitored to determine its success in increasing vegetation diversity and its utilization by wildlife.

The FWMWG recommends the Rock Island District-Corps of Engineers to complete the dredging and habitat development project and monitoring program described in the Technical Report for the Fulton Local Flood Protection Project-Stage IIIC.

1. General problem addressed:

   (4) There is a lack of ability to predict the response of fish and wildlife resources to alterations of the river environment.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   Identify and discuss alteration methods and measures which will improve habitat in off-channel areas.

4. Tasks accomplished to address problem:

Provide input in the selection of borrow and disposal sites for the Fulton Flood Control Project.
Literature Review.

5. Listing of alternatives to problem:

a. The COE should complete the dredging and habitat development project described in the Technical Report for the Fulton Local Flood Protection Project-Stage IIIC .
b. No action.

6. Selected alternative: ____a____

7. Rationale for selection of alternative:

This study provides an excellent opportunity to discern benefits/impacts of dredging backwaters, increasing elevation of river islands and creation of habitat. Further, the study will provide insight into costs, equipment and regulatory processes involved in this work.

8. References used to select alternative:

FWMWG Discussion
Discussions with Waterways Experiment Station, Vicksburg, MS
"Handbook for Terrestrial Wildlife Habitat Development on Dredged Material", U.S. Waterways Experiment Station Technical Report D-78-37, July 1978.
Final EIS for Fulton Local Flood Protection Project

9. Rationale for elimination of other alternatives:

b. will not provide necessary information.

10. Preliminary impact assessment of selected alternative:

The dredging project will have the following impacts (the impacts of levee construction are identified in the EIS for the flood control project):

Physical - change in substrate from silt to sand, increased depth in backwater, resuspension of nutrients during dredging, increased dissolved oxygen concentrations, lower summertime temperatures, and increased flow. Up to 20 acres will be disturbed by disposal of the silt material.
Habitat - Loss of silver maple-cottonwood habitat. Potential for improved aquatic habitat by deepening backwaters and removal of silt and detritus. Potential for improved wildlife habitat by introducing valuable food and cover species and increased species diversity.

Fish - Increased species diversity. Reduction in the potential of winter fish kills. Improved spawning substrate. Extension of the life of the backwater as available fishery habitat.
Wildlife - Improved habitat for waterfowl, deer, small mammals, and passerine birds.
Endangered Species - No bald eagle roost trees will be impacted.
Benthos & Other Resources - Adverse impact to silt-tolerant species such as midges and worms. Beneficial habitat for species such as mayflies, stoneflies, and caddisflies. Improved benthos habitat.
Water Quality - Potential adverse impacts in resuspension of nutrients and return flow from the spoil site. Impacts are localized and should not significantly affect the water quality of the backwater area.
Air & Noise - Construction impacts only.
Energy - Construction energy costs, temporary and not significant.
Aesthetics - Beneficial in increasing habitat diversity and reducing backwater demise.
Management Areas - Spoil sites are located on the Upper Mississippi Wild Life and Fish Refuge. If successful, habitat diversity will be increased.
Recreation - Sport fishery should be significantly improved in dredged sloughs. Thus enhancing angler success. Potential for improved hunting. RID public use area may have minor impacts associated with an adjacent spoil site.
F&W Commercial - Potential for improvement of trapping and commercial fishing success.
Economic - Costs, if any over dredging from the UMR main channel for levee material. Administrative costs of monitoring program. Cost of revegetating disposal sites.
Community - No significant impact.
Social - No significant impact.

RECOMMENDATION #3027
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Cost of dredging and site preparation	$	Fulton (IL) Levee project will assess backwater dredging and spoil site rehabilitation only as a by-product of dredging for levee material	Fulton Levee project will proceed, levee material from main channel	Levee material obtained backwater	Minimal additional cost
Alteration of aquatic habitat	Acres	Aquatic habitat is too shallow to support fish or allow boating access	Shallow water will eventually succeed to willow/cottonwood and bottomland hardwood forest	Deepen 24± acres of backwater by 2-6 feet	Increase diversity, preserve aquatic habitat, improve access
Alteration of other habitats	Acres	Currently bottomland hardwoods	Increase of 15± acres of wooded habitat	Raise elevation of 20± acres of bottomland hardwoods and plant mast trees and other beneficial wildlife vegetation	Increase diversity on 20± ac.
Energy use		Unknown	No change	Additional energy used to prepare habitat development sites	Increased use by unknown amount
Manpower requirements for planting and monitoring	Man days/$	Fulton Levee project will require approximately 20 mandays @$150/day = $3000	No project, no cost	20 MD/$3000	20 MD/$3000

RECOMMENDATION #3027 (cont.)
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Additional knowledge for decision-making		Currently very little data exists regarding impact of dredging backwaters or of spoil site management and reclamation	Data may be gained slowly and haphazardly	Data will enable decision-makers and resource managers to better provide for the environmental values in their planning process	Improved decision-making

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3030

Pool Number All

River Mile District-Wide

Date Approved by Work Group 1-16-80

The Fish and Wildlife Management Work Group has participated in review, selection and designation of short and long-term disposal sites for dredge spoil. Designated sites were the result of intense review and in most cases, compromise. Sites with potentially adverse environmental effects have been selected for disposal on a short-term basis because of current equipment or economic limitations to move dredge spoil to a preferred site is unavailable.

Monitoring projects designed to document the impacts of dredge disposal on short-term sites are desired to evaluate the site selection process and to aid in finalizing the long-term disposal plan. A monitoring program should include identification of pre- and post-disposal vegetation and other habitat characteristics, evaluation of the relative stability of the spoil material at the site during and following the dredging operation and land use changes in the area. Information gained through monitoring should help to refine disposal techniques and criteria for future disposal site selection.

The FWMWG recommends that the RID in coordination with the UMRCC monitor all short-term disposal sites to document the impacts of dredge spoil disposal on fish and wildlife resources.

The FWMWG further recommends that the UMRCC develop a plan for the RID to monitor all short-term disposal sites to document the impacts of dredge spoil disposal on fish and wildlife resources. The RID should implement the plan and make the results available to the UMRCC and federal and state resource agencies in order that they may evaluate the short-term disposal plan.

1. General problem addressed:

   (4) There is a lack of ability to predict the response of fish and wildlife to certain alterations of the river environment.

2. Sub-problem addressed:

   Use of selected short-term disposal sites may have unavoidable, and negative environmental effects. These sites should be monitored to determine impacts of dredge spoil.

3. Sub-objective addressed:

   (2) Recommend and encourage the implementation of navigation project operation and maintenance programs and practices which preserve, restore or enhance fish and wildlife resources. Recommend the implementation of interagency fish and wildlife committee to coordinate programs and practices.

4. Tasks accomplished to address problem:

   (14) Participate in selection of short and long-term disposal sites to minimize impacts on fish and wildlife resources.
   (9) Literature review on effects of navigation project operation on fish and wildlife.

5. Listing of alternatives to problem:

   a. No further action, do not monitor effects of dredge spoil on short-term disposal sites.
   b. The UMRCC should develop a plan for the RID to monitor all short-term disposal sites to document the impacts dredge spoil disposal on fish and wildlife resources. The RID should implement the plan and make the results available to the UMRCC and federal and state resource agencies in order that they may evaluate the short-term disposal plan.

6. Selected alternative: b

7. Rationale for selection of alternative:

   Negative effects of dredge spoil introduced into river habitat has been documented. Potential for removing dredge spoil to environmentally acceptable long-term sites has not yet been met at all dredge cuts. Consequently, spoiling on some short term sites will have negative environmental effects. Monitoring of habitat and/or populations on these sites can document effects of disposal and provide information to improve disposal techniques.

8. References used to select alternative:

   GREAT II FWMWG Bibliography
   FWMWG Discussion
   On-site Inspection Team Discussion

9. Rationale for elimination of other alternatives:

   a. Will not meet the objective.

10. Preliminary impact assessment of selected alternative:

The monitoring program will not have any significant environmental impacts. There will be administrative costs to RID that will be in addition to water quality monitoring costs. As information is collected changes may be recommended for disposal of dredged material that would preserve and protect existing habitat. For a more detailed discussion of the impacts of a monitoring program, see FWMWG Recommendation #3026.

RECOMMENDATION #3030
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
<u>Direct</u> Costs of monitoring program including development	$	$0	$0	$14,000/year	+ $14,000/year for 3 to 5 years
<u>*Indirect*</u> Protection of fish and wildlife resources	acres	an average of 90 acres of backwater habitat are affected each year	status quo, some reduction in impacts through more stringent environmental regulations	reduction of acres impacted through improved mitigation techniques	reduction in acres impacted in long-run.

VIII. B. 5. Problem 5

Fish and wildlife are affected by industrial, recreational, agricultural, and municipal encroachment.

FWMWG 3039

The FWMWG recommends that a comprehensive plan for the management of the fish and wildlife resources of Pool 19 should be developed and implemented by the Iowa Conservation Commission, Illinois Department of Conservation, and U.S. Fish and Wildlife Service. The FWIC should be responsible for development of the plan and should guide, coordinate and give highest priority to this plan in the plan developed in FWMWG #3017.

FWMWG 3017

The FWMWG recommends development and implementation of comprehensive plans for the management of fish and wildlife resources within the river corridor by the agencies responsible for fish and wildlife resources. The Fish and Wildlife Interagency Committee (FWIC) should be responsible for development of the plan and should guide and coordinate the plan so that it is compatible for inclusion in the comprehensive land use plan for the UMR corridor (FWMWG 3016).

FWMWG 3016

The FWMWG recommends that a comprehensive land use plan for the UMR corridor be developed and implemented by all entities with an interest in the river. The plan should consist of the necessary strategic and operational components to make explicit the background, objectives, policies, coordination measures and procedures by which to operate.

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3039

Pool Number 19

River Mile Entire Pool

Date Approved by Work Group 1-16-80

Pool 19 (Keokuk Pool) of the UMR is the most important inland area for diving ducks in North America. Diving ducks depend heavily on Pool 19's rich supply of benthic organisms (primarily fingernail clams) for a source of food during the fall and spring migration. However, chemical and ecological parameters indicate that the Pool is in trouble ecologically and may be on the brink of collapse as an ecosystem. Resource management of this Pool is necessary to preserve its unique stature.

It is the oldest and longest of the pools, covering over 46 miles and 30,000 acres. Multiple demands for it's use include the generation of hydroelectric power, commercial navigation, sport and commercial fishing, hunting and trapping, recreational boating and others. Management of Pool 19 for fish and wildlife becomes increasingly difficult as these various demands increase, and is compounded by private ownership of nearly all the adjoining land areas and submerged lands. Piecemeal development and impacts by private citizens, industry, and municipalities are having a cumulative effect which must be more closely monitored and regulated to ensure protection of fish and wildlife resources.

Management strategies are available, and some have been recommended to enhance Pool 19 for specific components of the fish and wildlife community and their utilization. However, there is a need to coordinate these various strategies and management objectives between the agencies and interests involved for proper management of the fish and wildlife resources as a whole. This comprehensive management plan for the fish and wildlife resources of Pool 19 is needed to enhance those resources and to better protect them from adverse impacts on encroachment, development, potential spills of hazardous materials, and other demands. A plan should consider methods to place more lands in the pool under public management. Priority should be given to developing a cooperative agreement with Union Electric Company.

The FWMWG recommends that a comprehensive plan for the management of the fish and wildlife resources of Pool 19 should be developed and implemented by the Iowa Conservation Commission, Illinois Dept. of Conservation, and U.S. Fish and Wildlife Service. The FWIC should be responsible for development of the plan and should guide, coordinate and give highest priority to this plan in the plan developed in FWMWG #3017.

1. General problem addressed:

   (5) Fish and wildlife are affected by industrial, recreational, agricultural, and municipal encroachment.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   Identify the extent of the area and habitat, if possible, which has been usurped by industrial, agricultural or municipal development . Recommend the implementation of land use planning along the Upper Mississippi River to assure that necessary development is orderly and with minimal impacts on fish and wildlife resources.

4. Tasks accomplished to address problem:

   Reviewed historic and recent aerial photos. Reviewed literature on effects of various development and encroachment of fish and wildlife.

5. Listing of alternatives to problem:

   a. No action
   b. A comprehensive plan for the management of the fish and wildlife resources of Pool 19 should be developed and implemented by the Iowa Conservation Commission, Illinois Dept. of Conservation, and U.S. Fish and Wildlife Service. The FWIC should be responsible for development of the plan and should guide, coordinate, and give highest priority to this plan for inclusion in the plan developed in FWMWG #3017.

6. Selected alternative: b

7. Rationale for selection of alternative:

   This plan would provide a basis for combating the piecemeal encroachment on fish and wildlife habitat in Pool 19 and other actions and demands which have a deleterious impact on fish and wildlife resources. The plan should also ensure that management of fish and wildlife resources in Pool 19 was directed towards the resource as a whole rather than independently toward individual components.

8. References used to select alternative:

   FWMWG Discussion
   "Evaluation of Pool 19's Biological Significance and Vulnerability to Industrialization". Illinois Department of Conservation, August 14, 1978.

9. Rationale for elimination of other alternatives:

   a. will not affect the desired change.

10. Preliminary impact assessment of selected alternative:

    Development of the plan will not cause any significant impacts. Potential impacts of implementation of a comprehensive plan are discussed in FWMWG Recommendations #3016 and #3017.

RECOMMENDATION #3039
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Cost of developing plan	$	$0 No active planning	$0, piecemeal planning	Up to $60,000 depending on available information	+$60,000
Indirect Protection of fish and wildlife habitat	Acres and habitat quality	Loss of habitat	Continued loss of habitat	Improved management and protection decisions	Improved habitat quality on the 30,000 acres of the pool

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3017

Pool No. All

River Mile District Wide

Date Approved by Work Group 1-16-80

The FWMWG is charged with determining the means and to make recommendations for preserving, protecting and enhancing the fish and wildlife resources of the Upper Mississippi River (UMR). Many lands and waters on the river are identified as fish and wildlife management areas and are managed by Federal and State resource agencies. These managed areas amount to less than half of the unprotected floodplain. The other lands and waters on the river also provide an immense resource of great value to fish and wildlife populations.

Fish and wildlife resources of the unmanaged lands have been, and continue to be, threatened by competing resource uses including industry, navigation, agriculture, recreation and municipal interests. Balancing these resource uses with fish and wildlife concerns is a major challenge which calls for coordinated, and complete planning for fish and wildlife resources.

The FWMWG recommends development and implementation of comprehensive plans for the management of fish and wildlife resources within the river cooridor by the agencies responsible for fish and wildlife resources. The fish and wildlife interagency committee (FWIC) should be responsible for development of the plan and should guide and coordinate the plan so that it is compatible for inclusion in the comprehensive land use plan for the UMR cooridor (FWMWG 3016).

1. General problem addressed:

   (5) Fish and wildlife are affected by industrial, recreational, agricultural and municipal encroachment.

2. Sub-problem addressed:

   There is no comprehensive management plan for fish and wildlife resources within the UMR cooridor.

3. Sub-objective addressed:

   Identify the extent of the area and habitat, if possible, which has been usurped by industrial, agricultural, recreation and municipal development. Recommend the implementation of a land use plan to assure and orderly use of the UMR by all interests, restoration of habitat, actions to reduce impacts.

4. Task accomplished to address problem:

Task 1, 5 & 6. Literature review.
Task 2, gross analysis of habitat change due to sedimentation, navigation project, and encroachment by competing resource uses.

5. Listing of alternatives to problem:

   a. No action, no comprehensive planning for fish and wildlife resources.
   b. Fish and Wildlife management planning by individual agencies for land and water resources under their supervision.
   c. A comprehensive plan for the management of fish and wildlife resources within the UMR cooridor should be developed and implemented by agencies responsible for these resources. The FWIC should be responsible for development of the plan and should guide and coordinate the plan so that it is compatible for inclusion in the plan developed in FWMWG recommendation #3016.

6. Selected alternative ___c___ .

7. Rationale for selection of alternative:

Development of river resources for industrial, agricultural, recreational and municipal purposes affects carrying-capacity for fish and wildlife. Comprehensive planning for fish and wildlife resources can provide a foundation to insure that fish and wildlife resources receive equitable consideration in river development. Comprehensive planning is needed to establish management goals and is necessary for development of a total land use plan, recognizing all resources and their uses.

8. References used to select alternative:

FWMWG discussion
Side Channel Work Group II draft Appendix

9. Rationale for elimination of other alternatives:

   a. does not meet objective.
   b. does not meet objective.

10. Preliminary impact assessment of selected alternative.

Development and implementation of a comprehensive management plan will benefit all fish and wildlife resources.

Since this plan must be closely coordinated with a comprehensive land use plan to be completely effective, see impact discussion under FWMWG 3016.

RECOMMENDATION #3017
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Cost of development of plan	$	Planning for Mark Twain National Wildlife Refuge Complete	Approximately $120,000 will be spent on planning for UMR Wildlife and Fish Complex (approximately 36% of pools 11-14. Does not include comprehensive aquatic resource planning)	Up to $2,000,000 for fish and wildlife management planning on Pools 11-22. However, comprehensive plan must include all UMR	+ $2,000,000 *
Indirect Protection of fish and wildlife habitat	Acres	Individual federal and state agency planning	Status quo. Refuge plans will address terrestrial concerns on refuge only. No comprehensive plan for UMR	Complete comprehensive plan for entire river	Protection of 1.0 million acres of UMR habitat

*Costs very dependent on initiation of FWMWG 3026, 3024, 3013, 3031, and 3014.

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3016

Pool No. All

River Mile District Wide

Date Approved by Work Group 3-3-80

Protection and management of the fish and wildlife resources of the Upper Mississippi River (UMR) has become increasingly difficult as the industrial, recreational, agricultural, and municipal demands on the river increase. Piecemeal development and their environmental impacts are having a cumulative effect on the natural resource base of the river. Over the last 20 years over 4500 acres of valuable floodplain habitat has been directly lost to these encroachments. Countless other acres have been indirectly impacted by such activities as degradation of air and water quality, erosion, and human encroachment. In order to protect all "users" of the river, industrial, recreational, agricultural, and municipal encroachment needs to be more closely monitored and regulated.

The FWMWG recommends that a comprehensive land use plan for the UMR corridor be developed and implemented by all entities with an interest in the river. The plan should consist of the necessary strategic and operational components to make explicit the background, objectives, policies, coordination measures and procedures by which to operate.

1. General problem addressed:

   (5) Fish and wildlife are affected by industrial, recreational, agricultural, and municipal encroachment.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   (5) Identify the extent of area and habitat, if possible, which has been usurped by industrial, agricultural, or municipal development. Recommend the implementation of a land use plan to assure an orderly use of the river by all interests.

4. Tasks accomplished to address problems:

   (2) Review historic and recent aerial photographs of GREAT II study area.
   (15) Review literature concerning effects of industrial, municipal, recreational, and agricultural encroachment on fish and wildlife resources.

5. Listing of alternatives to problem:

   a. A comprehensive land use plan for the UMR corridor should be developed and implemented by all entities with an interest in the river. The plan should consist of the necessary strategic and operational components to make explicit the background, objectives, policies, coordination measures and procedures by which to operate.
   b. No action.

6. Selected alternative ___a___.

7. Rationale for selection of alternative:

   A comprehensive land use plan is necessary to meet the continual demands placed on the river by all interest groups. The plan will ensure each entity's needs will be considered and be compatible without impacting on other special interest needs.

8. References use to select alternative:

   FWMWG discussion
   P.L. 95-502 Replacement of Locks and Dam 26, Upper Mississippi River System Comprehensive Master Management Plan.

9. Rationale for elimination of other alternatives:

   b. Does not affect desired change.

10. Preliminary impact assessment of selected alternative:

   Development of a comprehensive land use plan will not have any significant environmental impacts. Implementation of a plan could have the following impacts:

   Physical - impacts will depend upon the specifics of the land use plan.
   Habitat - overall habitat preservation, likely. All alternatives to a particular land-use will be evaluated and appropriate mitigative measures identified.
   Fish - preservation of habitat.
   Wildlife - preservation of habitat.
   Endangered Species - protection of habitat.
   Other Resources - preservation of habitat.
   Water Quality - selected local impacts only. No further degradation.
   Air and Noise - no additional degradation. Selected local impacts only.
   Energy - depends on specifics of plan. If plan were to improve transportation systems, energy resources would be benefited.

Aesthetics - preservation, possible enhancement through improved planning.

Management Areas - possible increase in lands set aside for fish and wildlife resources. Reduction in adjacent land-use encroachment through improved planning for compatible uses.

Recreation - potential for improved hunting and fishing.

Commercial Fish and Wildlife Utilization - potential for improved fishing and trapping.

Economic - unknown impacts associated with requirements of plan.

Community - improved planning.

Social - improved protection of cultural resources.

RECOMMENDATION #3016
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Planning costs	$	piecemeal planning $0	status quo $0	development of plan in excess of $12,000,000	+ $12,000,000 or more for entire UMR
		SEE PLAN FORMULATION APPENDIX FOR COMPLETE ANALYSIS OF THIS RECOMMENDATION.			
Indirect Protection of fish and wildlife resources	SEE FWMWG RECOMMENDATION #3017				

VIII. B. 6. Problem 6

Effluent from municipal, agricultural, and industrial activities affect fish and wildlife resources.

FWMWG 3021

The FWMWG recommends that contingency plans for the resource agencies which stress the protection of fish and wildlife resources should be developed for quick response to toxic spills in each pool. These plans should be coordinated by USFWS in conjunction with state resource agencies and the Regional Pollution Response Team.

FWMWG 3022

The FWMWG recommends that the U.S. EPA expedite and strictly enforce regulations that require all industries located in the floodplain, which produce or store toxic materials, to be floodproofed.

FWMWG 3037

The FWMWG recommends that the U.S. Coast Guard should strictly enforce existing regulations and complete with due haste proposed regulations which protect the waters of the UMR from potential spills from barging related transport, transfer, storage, and handling of toxic and hazardous materials.

FWMWG 3038

The FWMWG recommends that the U.S. EPA and state implementing agencies strictly enforce existing regulations and complete with due haste proposed regulations which protect the waters of the UMR from potential spills from industrial or municipal related transport, transfer, storage and handling of toxic and hazardous materials. Specific funding should be sought to give priority to the UMR to adequately enforce these regulations.

FWMWG 3020

The FWMWG recommends that the Federal Railroad Administration should recognize the potentially serious environmental impact of a rail accident involving hazardous materials on railroad lines bordering the Upper Mississippi River, and should place a high priority on safety enforcement efforts on those lines. The Federal Railroad Administration should also take any steps necessary to assure that information about required responses to spills and other accidents is readily available to the railroads.

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3021

Pool Number All

River Mile District-wide

Date Approved by Work Group 3/3/80

The President's Council on Environmental Quality has established a National Oil and Hazardous Substances Pollution Contingency Plan. As a part of this plan a Regional Response Team (RRT) was formed for the North Central Region. This RRT is responsible for responding to all pollution emergencies in the GREAT II study area. The RRT is chaired by U.S. Environmental Protection Agency (EPS). Its members consist of federal agencies and State liasons. The RRT is to provide for efficient, coordinated and effective action to minimize damage from oil and hazardous substances discharges, including containment, dispersal and removal.

The U.S. Fish and Wildlife Service (FWS) represents fish and wildlife resources on the RRT. Response equipment for the fish and wildlife resources of the Upper Mississippi River (UMR) is maintained at the FWS facilities in LaCrosse, Wisconsin. Due to location and small amount of equipment and the numbers of trained personnel, immediate response is not always possible, especially in the lower pools. In addition, spoil containment equipment designed for riverine use is almost non-existent. Pool by pool planning should include containment equipment, staging areas, and training for proper deployment to protect sensitive areas.

In many cases the chemical composition and source of a hazardsou spill is unknown and mortality of biological species is the only indicator of a spill. A quick response of the RRT could avert a natural disaster on the UMR. The RRT's collection of biological and water quality samples and deployment of containment structures could be facilitated by establishment of a contingency plan for each of the pools of the UMR. This plan would ensure necessary equipment (booms, staging areas, collection bottles, etc.) and trained personnel would be available in each pool for quick response to any spill.

Planning and funding or reimbursement for post-spill assessment by State and federal personnel and mitigation strategies should be addressed by the plan. The costs oi planning should be borne by the State and federal resource agencies. However, the costs of implementing the plan and costs incurred by the RRT as a result of a spill occurrence should not be borne by the general public but, for instance, by handlers of toxic and hazardous materials in the UMR floodplain and floodplain of major tributaries.

The FWMWG recommends that contingency plans for the resource agencies which stress the protection of fish and wildlife resources should be developed for quick response to toxic spills in each pool. These plans should be coordinated by U.S. FWS in conjunction with state resource agencies and the Regional Pollution Response Team.

1. General problem addressed:

   (6) Effluent from municipal, agricultural and industrial activities affect fish and wildlife resources.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   (6) Identify measures and practices to reduce water quality impacts on fish and wildlife resources.

4. Tasks accomplished to address problem:

   (18) Review literature concerning effects of industrial, municipal, recreational and agricultural encroachment on fish and wildlife resources.

5. Listing of alternatives to problem:

   a. Contingency plans for the resource agencies which stress the protection of fish and wildlife resources should be developed for quick response to toxic spills in each pool. These plans should be coordinated by U.S. FWS in conjunction with state resource agencies and the Regional Pollution Response Team.
   b. No action.

6. Selected alternative ___a___ .

7. Rationale for selection of alternative:

   Potential impacts to fish and wildlife resources following accidental spills, require immediate expert response to minimize these impacts.

8. References used to select alternative:

   FWMWG Discussion.
   Pollution Response Plan for Oil and Hazardous Substances, U.S. FWS, North Central Region.
   40 CFR Part 1510

9. Rationale for elimination of other alternatives:

   Does not achieve objective.

10. Preliminary impact assessment of selected alternative:

Development of a contingency plan for each pool will not have any significant environmental impacts. Establishing and training response teams for each pool may require additional funding as well as will protection equipment. Action by the response teams will help to preserve and protect fish and wildlife resources impacted or threatened by hazardous or toxic spills.

RECOMMENDATION #3021
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct					
Cost of equipment and staging areas	$ (year 0)	$0	$0	$628,000 ($200,000/river mile)	+ $628,000
Maintenance costs	$	$0	$0	$364,000/year (includes complete replacement every 10 years)	+ $364,000/year
Administrative costs	man-days/year ($175/man-day)	58 man-days/year ($10,150/year)	58 man-days/year ($10,150/year)	598/year ($104,650/year)	+ $94,500
Indirect					
Protection of fish and wildlife habitat	acres	10^6 acres on entire UMR	$+10^6$ acres due to increase in use of hazardous and toxic materials	10^6 acres of habitat impacted	protection of 10^6 acres of UMR habitat

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3022

Pool No. All

River Mile District Wide

Date Approved by Work Group 1-16-80

The unregulated production and storage of toxic chemicals in the floodplain poses a threat to fish and wildlife as well as human health. A toxic chemical spill during a high water event could have catastrophic effects on fish and wildlife resources. Spills occurring near a municipal water intake could contaminate drinking water supplies and go unnoticed for several days or weeks.

During flooding, temporary backwaters with little or no flow are formed. Spills occurring in these areas would not be diluted as quickly as those in the main channel where flow and mixing is greater. There is a much greater risk of inundated bottomlands accumulating these toxic chemicals in their soil and vegetation as floodwaters recede.

Other than laws concerning the transportation and disposal of toxic chemicals, there are no regulations regarding their storage and production in the floodplain. The U.S. Environmental Protection Agency (EPA), however, is now drafting regulations to alleviate this shortcoming. These proposed regulations will be released in mid-1980.

The FWMWG recommends that the U.S. EPA expedite and strictly enforce regulaticns that require all industries located in the floodplain, which produce or store toxic materials, to be flood-proofed.

1. General problem addressed:

   (6) Effluent from municipal, agricultural and industrial activities affect fish and wildlife resources.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   Identify measures and practices to reduce water quality impacts on fish and wildlife resources.

4. Tasks accomplished to address problem:

   Review current regulations on storage of toxic chemicals and wastes in the floodplain. Discussion with State and Federal

EPA. Work group discussion. Review literature regarding effects of point and non-point discharges on fish and wildlife resources.

5. Listing of alternatives to problems:

   a. Prohibit storage and production of toxic chemicals and wastes within floodplain.
   b. No action
   c. U.S. EPA should expedite and enforce regulations that require that all structures housing or producing toxic chemicals be protected from flooding.

6. Selected alternative ___c___ .

7. Rationale for selection of alternative:

   A flood event could result in an accidental spill to toxic materials into waters of the Upper Mississippi River (UMR) and loss of significant fish and wildlife resources. For instance, a major toxic spill in Pool 19 could destroy the fingernail clam population of the pool and thereby affect the national population of canvasback ducks.

8. References used to select alternative:

   FWMWG discussion.
   Discussion with State and Federal EPA.
   Review of current regulations on storage of toxic chemicals and wastes in the floodplain.
   GREAT II Water Quality Work Group (WQWG) Appendix.
   40 CFR Part 250
   43 FR 58946-59025

9. Rationale for elimination of other alternatives:

   (a) severely constrains existing floodplain development. Selected alternative will also meet objective.
   (b) will not affect desired change.

10. Preliminary impact assessment of selected alternative:

    Adoption of the regulations will not have any significant impacts. Implementation and enforcement of floodproofing or other protection from flooding will have the following impacts:

    Physical - Construction of containment areas, structural modification, removal of toxic materials form the floodplain prior to flooding.
    Habitat - Protection of aquatic and floodplain habitat. Reduction in potential for bioaccumulation of toxic materials.

Fish - Protection of habitat. In the short-term, toxic spills could affect localized populations or populations of an entire pool depending on magnitude of spill. In the long-term, the chemicals could persist and result in chronic impacts related to bioaccumulation or interruption of the food web. The selected alternative can prevent these types of impacts.

Wildlife - Protection of habitat. Same type of impacts as identified for fish can be prevented.

Endangered Species - Protection of habitat. Same type of impacts as identified for fish can be prevented.

Benthos - Protection of habitat. It has been demonstrated that spilled substances persist longest in sediments, and in benthic organisms, such as mussels.

Water Quality - Reduced potential for major toxic spill during flooding. Protection of municipal and industrial water supplies.

Air and Noise - No impact.

Energy - Possible energy cost if material is removed from the floodplain.

Aesthetics - Protection from significant resource loss.

Management Areas - Protection of habitat.

Recreation - Protection from significant resource loss.

Fish and Wildlife Commercial - Protection from significant resource loss.

Economic - Protection requirement will incur additional costs to industry. Will probably require additional funding and manpower of U.S. EPA to enforce.

Community - No significant impact.

Social - No significant impact.

RECOMMENDATION #3022
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Administrative costs	man-days/year ($175/man-days/year)	0 man-days ($0) (new regulations)	minimal additional expenditures due to personnel constraints	230 man-days/year ($40,250/year)	+ 230 man-days/year ($40,250/year)
Indirect Protection of fish and wildlife habitat	acres	unknown loss of habitat	additional habitat losses	reduction in habitat losses	unknown acres of habitat protected
Reduction in cost of FWMWG #3021	$	?	?	?	?

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3037

Pool Number: All

River Mile: District-wide

Date Approved by Work Group: 3/3/80

Many regulations concerning the transportation of hazardous materials by vessel have been either proposed or adopted. Applicable regulations are found in the Code of Federal Regulations Title 49, parts 171, 176 and 46 CFR parts 30-40, 64, 98, 148, and 151. These standards contain regulations for transportation, loading, unloading, handling, storage, leaking containers, accident reporting, and containerization of hazardous materials. In addition, rules have been proposed concerning transporters of hazardous waste (Federal Register Vol. 43, No. 83, pages 18506-18512 be implemented).

The FWMWG recommends that the U.S. Coast Guard should strictly enforce existing regulations and complete with due haste proposed regulations which protect the waters of the UMR from potential spills from barging related transport, transfer, storage, and handling of toxic and hazardous materials.

1. General problem addressed:

   (6) Effluent from municipal, agricultural and industrial activities affect fish and wildlife resources.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   (6) Identify measures and practices to reduce water quality impacts on fish and wildlife resources.

4. Tasks accomplished to address problem:

   (19) Review literature concerning effects of point and non-point discharges on fish and wildlife resources.

5. Listing of alternatives to problem:

   a. The U.S. Coast Guard should strictly enforce existing regulations and complete with due haste proposed regulations which protect the waters of the UMR from potential spills from barging related transport, transfer, storage and handling of toxic and hazardous materials.

   b. No action.

6. Selected alternative: a

7. Rationale for selection of alternative:

   The proposed rules, when finalized, will require strict enforcement to ensure protection of fish and wildlife resources on the UMR.

8. References used to select alternative:

   Clean Water Act
   U.S. EPA (personal communication)
   49 CFR Parts 171 and 176
   46 CFR Parts 30-40, 64, 98, 148 and 151

9. Rationale for elimination of other alternatives:

   b. Does not hasten completion of proposed rules.

10. Preliminary impact assessment of selected alternative:

   Strict enforcement of existing and proposed regulations will protect fish and wildlife resources from accidental spills of hazardous or toxic materials. Enforcement will cause no additional costs to industry over and above the costs of compliance with the regulations.

RECOMMENDATION #3037
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Administrative costs	$	Current enforcement adequate	Enforcement will be adequate	Adequate enforcement	$0
Indirect Protection in fish and wildlife habitat	Acres	No specific loss of habitat due to enforcement inadequacies	Adequate habitat protection if proposed regulations are implemented	Reduction in spills of hazardous or toxic materials	Protection of fish and wildlife habitat
Reduction in cost of FWMWG 3021	$	?	?	?	?

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3038

Pool Number All

River Mile District-Wide

Date Approved by Work Group 3-30-80

In response to the Clean Water Act, the U.S. EPA has developed regulations to protect waters of the United States from potential spills of hazardous and toxic materials. Additional regulations regarding hazardous wastes have been proposed by U.S. Environmental Protection Agency 43 FR 58946-59028.

However, enforcement can only be commensurate with available funding which is minimal. Spills continue to occur. Considering the amount of hazardous and toxic materials transported, handled, and stored in the floodplain of the UMR, a great potential exists for a catastrophic accident affecting fish and wildlife resources. For instance, a single large spill in Pool 19 could affect the national population of canvasback ducks.

The FWMWG recommends that the U.S. EPA and state implementing agencies strictly enforce existing regulations and complete with due haste proposed regulations which protect the waters of the UMR from potential spills from industrial or municipal related transport, transfer, storage and handling of toxic and hazardous materials. Specific funding should be sought to give priority to the UMR to adequately enforce these regulations.

1. General problem addressed:

   (6) Effluent from municipal, agricultural and industrial activities affect fish and wildlife resources.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   (6) Identify measures and practices to reduce water quality impacts on fish and wildlife resources.

4. Tasks accomplished to address problem:

   (19) Review literature concerning effects of point and non-point discharges on fish and wildlife resources.

5. Listing of alternatives to problem:

   a. The U.S. EPA and state implementing agencies should strictly enforce existing regulations and complete with due haste proposed regulations which protect the waters of the UMR from potential spills from industrial or municipal related transport, transfer, storage and handling of toxic and hazardous materials. Specific funding should be sought to give priority to the UMR to adequately enforce these regulations.

   b. No action.

6. Selected alternative: a

7. Rationale for selection of alternative:

   Although regulations exist to protect the water quality of the UMR, occasional spills still take place. Strict enforcement could ensure protection of fish and wildlife resources of the UMR.

8. References used to select alternative:

   Clean Water Act
   U.S. EPA (personal communication)
   43 FR 58946-59028

9. Rationale for elimination of other alternatives:

   b. Only maintains status quo.

10. Preliminary impact assessment of selected alternative:

   Funding of U.S. EPA and appropriate state agencies will not have any significant environmental impacts. Strict enforcement of existing and proposed regulations will protect fish and wildlife resources from accidental spills of hazardous or toxic materials. Enforcement will cause no additional costs to industry or municipalities over and above those costs required for compliance with the regulations.

RECOMMENDATION #3038
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Administrative costs	man-days/year ($175/man-days/year)	0 man-days ($0) (new regulations)	Minimal additional expenditures due to personnel constraints	230 man-days/year ($40,250/year)	+ 230 man-days/year ($40,250/year)
Indirect Protection of fish and wildlife habitat	acres	unknown loss of habitat	additional habitat losses	reduction in habitat losses	unknown acres of habitat protected
Reduction in cost of FW&WC #3021	$	?	?	?	?

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3020

Pool Number All

River Mile District-wide

Date Approved by Work Group 3/3/80

In 1979, there were thousands of rail accidents in the U.S. involving both passenger and freight trains. Eighteen derailments occurred in 1979 on the west side of the river between Minneapolis and Sabula, Iowa. The primary causes of these accidents are poor tracks and roadbeds and speeds in excess of safety limits.

Each bank of the Upper Mississippi River (UMR) is lined with railroad tracks. Freight trains in the study area carry numerous cargos of toxic and hazardous materials. An accidental spill of any of these materials could have devastating impacts on fish and wildlife resources.

The FWMWG recommends that the Federal Railroad Administration should recognize the potentially serious environmental impact of a rail accident involving hazardous materials on railroad lines bordering the Upper Mississippi River, and should place a high priority on safety enforcement efforts on those lines. The Federal Railroad Administration should also take any steps necessary to assure that information about required responses to spills and other accidents is readily available to the railroads.

1. General problem addressed:

   (6) Effluent from municipal, agricultural, and industrial activities affect fish and wildlife resources.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   (6) Identify measures and practices to reduce water quality impacts on fish and wildlife resources.

4. Tasks accomplished to address problem:

   (19) Review literature regarding effects of point and nonpoint discharges on fish and wildlife resources.

5. Listing of alternatives to problem:

   a. The FWMWG recommends that the Federal Railroad Administration should recognize the potentially serious environmental impact of a rail accident involving hazardous materials on railroad lines bordering the Upper Mississippi River, and should place

a high priority on safety enforcement efforts on those lines. The Federal Railroad Administration should also take any steps necessary to assure that information about required responses to spills and other accidents is readily available to the railroads.

b. No action.

6. Selected alternative ___a___.

7. Rationale for selection of alternative:

Numerous derailments have occurred along the UMR. Unsafe tracks and operating speeds increase the potential for derailments and accidental spills of toxic materials which could severely impact fish and wildlife.

8. References used to select alternative:

FWMWG discussion.
U.S. Environmental Protection Agency and U.S. Fish and Wildlife Service (pers. comm.)

9. Rationale for elimination of other alternatives:

b. Does not meet objective.

10. Preliminary impact assessment of selected alternatives:

Increased safety on the railroads along the UMR will protect fish and wildlife resources and human health and safety. Administrative costs will be minimal.

RECOMMENDATION #3020
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Administrative Costs	man-days ($175/man-days/year)	essentially no cost in this regard	no additional costs	20 man-days/year ($3500/year)	+ 20 man-days/year (+ $3500/year)
Indirect Protection of fish and wildlife habitat	acres	unknown loss of habitat	additional habitat losses	reduction in acres of habitat impacted	unknown acres of habitat protected
Reduction in cost of FWMWG #3021	$	?	?	?	?

VIII. B. 7. Problem 7

Fish and wildlife are affected by commercial and recreational boat traffic.

FWMWG 3032

The FWMWG recommends that GREAT II support the UMRBC master planning effort to conduct a three-year study to address the impacts of commercial and recreational navigation on the fish and wildlife resource of the UMR. The study should include development of a predictive model to evaluate impacts of increased navigation on the river and its effects on fish and wildlife resources.

FWMWG 3033

The FWMWG recommends that GREAT II support the UMRBC master planning effort to:

(1) Identify measures that can be used for mitigation, restoration, protection, management and enhancement of environmental resources.
(2) Determine the adverse and beneficial impacts of each measure identified with respect to:
  (A) the environment,
  (B) national and regional economics, and
  (C) the social character of the region.
(3) Determine which of these measures identified can be immediately implemented.
(4) Determine costs and studies for those measures identified which will require demonstration projects to evaluate adverse and beneficial impacts.

FWMWG 3023

The FWMWG recommends that the RID should complete the biological studies necessary to understand the fish and wildlife impacts of providing a year-round navigation or establishing a closed navigation season. The biological studies should be thoroughly coordinated with all resource agencies on the UMR and the Upper Mississippi River Basin Commission (UMRBC) master management plan effort.

FWMWG 3034

The FWMWG recommends that the RID immediately protect fish and wildlife resources through their Section 10 authority under the Rivers and Harbors Act by eliminating all mooring to trees. The RID should also undertake studies in coordination with the state and federal resource agencies to assess the impacts of barge fleeting on the UMR. This assessment should be used to identify needed fleeting sites and measures which will protect fish and wildlife resources.

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3032

Pool No. All

River Mile District Wide

Date Approved by Work Group 3-3-80

The Upper Mississippi River (UMR) navigation system provides waterborne commerce to the entire Upper Midwest. Bulk commodities, such as grain and coal, represent the largest volume of cargo transported. Projections for the future vary, but indications are that river traffic could double or even triple in the next 40 years, depending on demand and the capacity of the new Lock and Dam 26 presently under construction at Alton, Illinois. Information gained from research included in this Recommendation will provide information for determining whether one or two locks should be included in the new Lock and Dam 26 project, as required by P.L. 95-502, Replacement of Locks and Dam 26, Upper Mississippi River System Management Plan.

Literature studies conducted as part of the UMR main stem level B study, GREAT II FWMWG literature reviews, and testimony in the Lock and Dam 26 trials reveal that very little is known about the direct environmental effects of vessels moving on the waterways. It has been hypothesized by many scientists that wave wash and the powerful thrusts of motorized propellers do indeed have significant impacts on the physical and biological components of the aquatic ecosystem. These impacts are poorly understood and must be thoroughly studied and documented before one can begin to speculate on the environmental impacts of significant traffic increases.

A study of this type is very complex and was beyond the scope of GREAT II FWMWG. However, P.L. 95-502 specifically recognized the need for this information. In order to meet the requirements of P.L. 95-502 the Upper Mississippi River Basin Commission (UMRBC) had drafted a work plan to evaluate the impacts of navigation and navigation project operation and maintenance procedures on selected environmental parameters.

The FWMWG recommends that GREAT II support the UMRBC master planning effort to conduct a three year study to address the impacts of commercial and recreational navigation on the fish and wildlife resource of the UMR. The study should include development of a predictive model to evaluate impacts of increased navigation on the river and its effects on fish and wildlife resources.

1. General problem addressed:

(7) Fish and Wildlife are affected by commercial and recreational boat traffic.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

(7) Identify detrimental effects of recreational and commercial traffic on fish and wildlife resources. Recommend measures to minimize impacts on fish and wildlife resources.

4. Tasks accomplished to address problem:

(10) Study use of the main channel by fish
(20) Review literature concerning effects of commercial and recreational traffic on fish and wildlife.

5. Listing of alternatives to problem:

   a. GREAT II should support the UMRBC master planning effort to conduct a three year study to address the impacts of commercial and recreational navigation on the fish and wildlife resources of the UMR. The study should include development of a predictive model to evaluate impacts of increased navigation on the river and its effects on fish and wildlife resources.
   b. No action

6. Selected alternative ___a___.

7. Rationale for selection of alternative:

Impacts of commercial and recreational navigation on the UMR are complex. A study of this nature was beyond the scope of GREAT II FWMWG.

8. References used to select alternative:

FWMWG discussion.
P.L. 95-502, Replacement of Locks and Dam 26, Upper Mississippi River System Comprehensive Master Management Plan
UMRBC master plan proposal - "Overview Work Plan for Evaluation of the Impacts of Navigation and Navigation Project Operation and Maintenance Procedures on Selected Environmental Parameters."

9. Rationale for elimination of other alternatives:

   b. Does not meet the requirement of P.L. 95-502.

10. Preliminary impact assessment of selected alternative:

Implementation of this study will not have any significant environmental impacts. Specific impacts of the study are similiar to those impacts discussed under FWMWG 3026.

RECOMMENDATION #3032
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Costs of study	$	$0	Funding dependent on Upper Mississippi Basin Commission and U.S. Congress	$2,500,000 to complete study identified by Water Planning efforts	up to $2,500,000
Indirect Protection of fish and wildlife habitat	habitat quality	Little or no reduction in impacts of commercial and recreational navigation	Status quo	Increased mitigation and improved management decisions	Improved habitat quality

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3033

Pool No. All

River Mile District Wide

Date Approved by Work Group 3-3-80

Present and future operation and maintenance of the 9-foot channel, industrial and urban development and other increasing demands on the Upper Mississippi River (UMR) ecosystems has and will ultimately result in losses of desirable fish and wildlife habitat. In addition, natural processes (mainly sedimentation) accelerated by urban and rural development, will cause losses of habitat.

Careful planning can minimize many of these impacts; however, significant losses of desirable resources will continue. To overcome this situation, resource managers need to identify and use mitigation and environmental enhancement techniques to replace lost habitats.

Construction of the new Lock and Dam 26 will undoubtedly increase impacts throughout the navigation system; therefore, mitigation and enhancement techniques must be available for resource managers and planners to use in developing the Upper Mississippi River System Master Plan (UMRS). The Upper Mississippi River Basin Commission (UMRBC) Master Planning (Pl 95-502) effort has developed a proposal to identify and review measures to enhance and mitigate environmental resources of the UMR system.

The FWMWG recommends that GREAT II support the UMRBC master planning effort to:

(1) Identify measures that can be used for mitigation, restoration, protection, management and enhancement of environmental resources.
(2) Determine the adverse and beneficial impacts of each measure identified with respect to:
   (A) the environment,
   (B) national and regional economies, and
   (C) the social character of the region.
(3) Determine which of those measures identified can be immediately implemented.
(4) Determine costs and studies for those measures identified which will require demonstration projects to evaluate adverse and beneficial impacts.

1. General problem addressed:

   (7) Fish and wildlife are affected by commercial and recreational boat traffic.
   (5) Fish and Wildlife are affected by industrial, recreational, agricultural, and municipal encroachment.

2. Sub-problem addressed: N/A

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3. Sub-objective addressed:

(7) Identify detrimental effects of recreational and commercial traffic on fish and wildlife resources. Recommend measures to minimize impacts on fish and wildlife resources.
(5) Recommend actions to reduce encroachment.

4. Tasks accomplished to address problem:

(18) & (20) Review literature concerning encroachment and commercial and recreational traffic on fish and wildlife resources.

5. Listing of alternatives to problem:

   a. Identify measures that can be used for mitigation, restoration, protection, management and enhancement of environmental resources.
   b. Determine the adverse and beneficial impacts of each measure identified with respect to:
      (1) the environment.
      (2) national and regional economies, and
      (3) the social character of the region.
   c. Determine which of those measures identified can be immediately implemented.
   d. Determine costs and studies for those measures identified which will require demonstration projects to evaluate adverse and beneficial impacts.
   e. GREAT II support the UMRBC master planning effort to study the above alternatives. (a,b,c,&d)
   f. no action.

6. Selected alternative ___e___.

7. Rationale for selection of alternative:

Careful planning can minimize many of these impacts; however, significant losses of desirable resources will continue. To overcome this situation,resource managers need to identify and use mitigation and environmental enhancement techniques to replace lost habitats.

8. References used to select alternative:

FWMWG discussion
P.L. 95-502, Replacement of Locks and Dam 26, Upper Mississippi River System Comprehensive Master Management Plan.
UMRBC Master Plan proposal - "Identification and Review of Measures to Enhance and Mitigate Environmental Resources of the Upper Mississippi River System."

9. Rationale for elimination of other alternatives:

a-d- need comprehensive study of all alternatives
f - does not provide desired information.

10. Preliminary impact assessment of selected alternative.

Collection information will have impacts similar to those described for FWMWG 3026.

RECOMMENDATION #3033
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Cost of study	$	$0 information lacking	$0 unknown piecemeal studies	up to $1,000,000 including planning, data collection, and analysis	+$1,000,000
Indirect Protection of fish and wildlife resources	Acres of habitat and habitat quality	Unknown acres of habitat lost to development. Loss in habitat quality	Continued losses of habitat and habitat quality	Better planning to reduce and mitigate habitat losses	Undetermined acres of habitat protected and/or habitat quality improved

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3023

Pool No. All

River Mile District Wide

Date Approved by Work Group 3-3-80

The Rock Island District (RID) is conducting studies to determine and evaluate the feasibility of providing an extended or closed navigation season on portions of the Upper Mississippi River (UMR). As discussed in the text of this appendix, extending the season could adversely affect fish and wildlife by forming large ice jams, degrade water quality, increase the potential for toxic spills, and increase bottom scouring and shoreline erosion. Conversely, a specific closed navigation season based perhaps on specific physical parameters could benefit fish and wildlife resources by reducing disturbances during a period when they are already severely stressed. To assess these impacts, the RID should at a minimum include the studies recommended by Midwest Research Institute report and the agencies commenting on the Year-Round Navigation studies.

The FWMWG recommends that the RID should complete the biological studies necessary to understand the fish and wildlife impacts of providing a year-round navigation or establishing a closed navigation season. The biological studies should be thoroughly coordinated with all resource agencies on the UMR and the Upper Mississippi River Basin Commission (UMRBC) master management plan effort.

1. General problem addressed:

   (7) Fish and wildlife are affected by commercial and recreational boat traffic.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

   (7) Identify detrimental effects of recreational and commercial traffic on fish and wildlife resources. Recommend measures to minimize impacts on fish and wildlife resources.

4. Tasks accomplished to address problem:

   (20) Review literature concerning effects of commercial and recreational traffic on fish and wildlife resources.

5. Listing of alternatives to problem:

   a. The RID should complete the biological studies necessary to understand the fish and wildlife impacts of providing year-round navigation or establishing a closed navigation season.
   b. The biological studies should be thoroughly coordinated with all resource agencies on the UMR and the UMRBC master management plan effort.
   c. A & B combined.
   d. No action.

6. Selected alternative ___c___ .

7. Rationale for selection of alternative:

   There is insufficient knowledge of the winter habitat requirements of fish and wildlife resources. This information is necessary before a decision can be made on establishing a closed navigation season or to ensure year-round navigation.

8. References used to select alternative:

   FWMWG discussion.
   LGL Ecological Research Associates. 1979. S.A. Summers, Study of Fish in the Main Channel of the Mississippi River Between River Miles 500.0 and 513.5. Interim Report. Prepared for GREAT II FWMWG.
   Midwest Research Institute. 1978. Environmental and Social Considerations of Mississippi River Year-Round Navigation Program.

9. Rationale for elimination of other alternatives:

   a. Does not include coordination.
   b. Is not specific to winter-time biological studies.
   d. Does not achieve objectives.

10. Preliminary impact assessment of selected alternative:

   Collection of information in order to make an environmentally aware decision will have impacts similiar to those described. for FWMWG 3026.

RECOMMENDATION #3023
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct Study costs	$	study needs still being developed	$1,216,000 per COE-RID estimate	$1,810,000 per MRI and other available estimates	+ $594,000
Indirect Protection of fish and wildlife resources thru better information for decision making	quality of habitat	winter navigation depending on ice conditions. Unknown impacts.	continued limited winter navigation. Unknown impacts	Knowledge of winter life requirements of fish and wildlife resources. Impacts and possible mitigation measures identified.	Protection of fish and wildlife resources.

FISH AND WILDLIFE MANAGEMENT WORK GROUP
(FWMWG) RECOMMENDATION #3034

Pool Number 3034

River Mile District Wide

Date Approved by Work Group 3-3-80

Barge fleeting may be thought of as the parking lots of the river. In the GREAT II area, fleeting sites are established at convenient places for barge operation. Unless structures such as mooring cells are placed in the river, this activity goes relatively unregulated by the Rock Island District-Corps of Engineers (RID). On the other hand, the policy in the St. Paul District is that barge fleeting affects the navigational capacity of the UMR, and; therefore, Section 10 permits are required for each fleeting site.

Frequently, fleeting adversely affects fish and wildlife resources. The most obvious effect is the harm done to trees and increased shoreline erosion. Barge fleeting is a 24 hour-a-day activity having inherent potential for wildlife and human distrubance. Nocturnal and diurnal animals are disturbed by noise, waves, lights, churning currents and overt human presence. In some instances, fleeting sites block side channels. They introduce additional sedimentation by resuspension of fine sediments. There are recognized hazards of spills or accidental discharges of toxic chemicals that are associated with barge fleeting and barge servicing and cleaning at fleeting sites. The particular site of a fleeting area may also be in conflict with other "users" of the river. Recreational access to side channels may be blocked. Access to prime fishing sites may be precluded or fishing patterns disturbed. Fleeting areas may sharply detract from the scenic and wild character of lands specifically set aside for fish and wildlife and may conflict with the management objectives of those areas.

To date, adequate studies to identify the primary, secondary and cumulative impacts of barge fleeting have not been undertaken to aid in siting of fleeting areas. Nor has there been an inventory of all fleeting on the river or a demand for additional fleeting sites established.

The FWMWG recommends that the RID immediately protect fish and wildlife resources through their Section 10 authority under the Rivers and Harbors Act by eliminating all mooring to trees. The RID should also undertake studies in coordination with the state and federal resource agencies to assess the impacts of barge fleeting on the UMR. This assessment should be used to identify needed fleeting sites and measures which will protect fish and wildlife resources.

1. General problem addressed:

    (7) Fish and wildlife are affected by commercial and recreational boat traffic.

2. Sub-problem addressed: N/A

3. Sub-objective addressed:

(5) Recommend actions to reduce the impacts of encroachment
(7) Identify detrimental effects recreational and commercial traffic have on fish and wildlife resources. Recommend measures to minimize impacts.
(6) Identify measures and practices to reduce water quality impacts on fish and wildlife resources.

4. Tasks accomplished to address problem:

(20) Review literature concerning the effects of recreational and commercial traffic on fish and wildlife resources.

5. Listing of alternatives to problem:

a. Rock Island District should eliminate all mooring to trees by exercising their authority under Section 10 of the Rivers and Harbors Act of 1899.
b. The impacts of barge fleeting on the UMR should be studied by the RID in coordination with the federal & state resource agencies.
c. Identify needed fleeting sites and measures which protect fish and wildlife resources.
d. A, B, and C combined.
e. No action.

6. Selected alternative: d

7. Rationale for selection of alternative:

Barge fleeting may adversely affect aquatic shorelines, cause additional soil erosion, and damage main channel border ecotones. These impacts need to be assessed and evaluated in order to establish measures and sites to protect fish and wildlife and meet navigational needs.

8. References used to select alternative:

FWMWG Discussion
Observations of fleeting areas on the river.

9. Rationale for elimination of other alternatives:

a. Does not assess cumulative impacts or sites.
b. Does not achieve recommended alternative a and c.
c. Does not achieve recommended alternative a and b.
e. Does not meet objective.

10. Preliminary impact assessment of selected alternative:

Requiring Section 10 permits for fleeting sites in the Rock Island District will have the following impacts:

Physical - Reduction of tying-off to trees. Probable increase in use of mooring cells.
Habitat - Protection of riparian and shoreline aquatic habitat.
Fish - Protection of shoreline cover habitat.
Wildlife - Protection of cavity trees used for nesting by wood ducks. Decrease in encroachment and associated disturbances.
Endangered Species - Possible protection of bald eagle day roost trees.
Benthos & Other Resources - Protection of benthos if mooring site moves to deeper water where resuspension of sediment is less likely.
Water Quality - Some decrease in shoreline erosion and resulting sedimentation.
Air & Noise - No impact
Energy - No impact
Aesthetics - Protection of habitat
Management Areas - Protection of habitat
Recreation - Minor benefit through protection of habitat
F&W Commercial - Minor benefit through protection of habitat.
Economic - Additional costs of mooring cells
Community - No impact
Social - No impact

Studies to assess the specific impacts of barge fleeting will have impacts similar to those described in FWMWG #3026. Identification of needed fleeting sites and measures to protect fish and wildlife resources will have impacts similar to those described in FWMWG #3016.

RECOMMENDATION #3034
IMPACT ASSESSMENT FORM

1. List Of Impacts	2. Units To Be Measured In	3. Present Condition As Of Jan. 1, 1979 For Each Impact	4. Description Of Most Probable Future (2025) Without Recommendations	5. Description of Most Probable Future (2025) With Recommendations	6. Measure Of Impacts
Direct					
Increase in Section 10 permits to be processed	permits	permits for mooring structures only	no additional permits	20-50 additional permits	+ 20-50 permits
Cost to RID of processing	$ ($5000/ permit)	$0	$0	$100,000-$250,000	+ $100,000-$250,000
Study impacts of barge fleeting and develop site plan	$	piecemeal evaluation of impacts $0	continued piecemeal evaluation $0	$200,000	+ $200,000
Indirect					
Protection of fish and wildlife habitat	acres	unknown acres of habitat impacted	additional indescriminate impacts to habitat	minimize and mitigate impacts to fish and wildlife habitat	unknown protection of acres of habitat

IX. PROBLEMS, RESULTS, AND CONCLUSIONS

Seven problems were idetified by the work group and were addressed. Seven additional problems were idetified by the public in August 1978. The majority of public-identified problems are addressed under the work group-identified problems. Some, however, were not addressed by the work group, and the reasons are below. The first seven problems discussed here are in priority order.

IX. A. PROBLEM 1

Problem: Fish and Wildlife are affected by turbidity and sedimentation resulting from upland and streambank erosion.

Was problem addressed? Yes.

Tasks:
- Review existing literature concerning value of off channel areas to fish and wildlife resources
- Review GREAT I Sediment and Erosion Work Group report
- Review historic and recent aerial photographs of GREAT II study area
- Review Soil Conservation Service erosion control practices and procedures
- Provide input in the selection of borrow and disposal sites for the Fulton Flood control project
- Review side channel opening reports
- Literature search - review (contracted item)
- Selection of short and long-term disposal sites
- Review literature concerning the creation of habitat with dredge material

Results and Conclusions: Literature reviews revealed: (1) the value of off-channel areas to fish and wildlife and impacts of construction, operation and maintenance of the 9-foot navigation channel on these areas, (2) methods to create or improve habitat. Our review of SCS practices, the GREAT I SEWG report and interpretation of aerial photographs revealed: (1) habitat lost due to sedimentation and the 9-foot navigation project, (2) effect of current land use practices to minimize erosion, (3) measures to increase effectiveness of erosion control. The ongoing Fulton Flood Control project should provide insight into the feasibility of restoring backwaters. Information on regulations, methods, equipment, impacts and benefits will be provided from this project.

Selection of short and long-term dredge material disposal sites will minimize the movement of material to backwaters. Results of the literature search are pending. However, it is expected information voids concerning effects of sedimentation on

various species of fish and wildlife will be discussed and studies to gather additional information suggested.

Recommendations: Having substantiated the effects of turbidity and sedimentation, the FWMWG made and approved five recommendations. Generally these are:

- FWMWG 3003 for U.S. Soil Conservation Service and U.S. Environmental Protection Agency to intensify efforts to control agricultural erosion within the UMR basin.
- FWMWG 3002 for U.S. Geological Survey to monitor backwater sedimentation rates.
- FWMWG 3035 to study priority areas for potential backwater restoration.
- FWMWG 3036 for RID, US FWS, and Iowa Conservation Commission to evaluate a levee for protection of a certain backwater complex.
- FWMWG 3028 for the COE to develop equipment to do large-scale backwater alterations.
- FWMWG 3006 to provide the COE with the funding necessary to perform selected backwater modifications.

A detailed discussion of these recommendations is contained in Section VIII. B. 1. of this report.

Recommendations concerning streambank erosion were not made. This portion of the problem has been adequately addressed by the GREAT II Sediment and Erosion Control Work Group and has been supported through the Plan Formulation Work Group evaluation process.

IX. B. PROBLEM 2

Problem: Fish and Wildlife resources are adversely affected by operation and maintenance practices associated with the navigation channel.

Was problem addressed? Yes.

Tasks:
- Review existing literature concerning value of off channel areas to fish and wildlife resources
- Review historic and recent photographs of GREAT II study area
- Review GREAT I SEWG report
- Provide input in the selection of borrow and disposal sites for the Fulton Flood control project
- Literature search and review (contracted item)
- Review literature to assess effects of the construction, operation and maintenance of 9-foot navigation project on fish and wildlife
- Study of the use of the main channel by fish (contracted item)

- Study of the effect of notching wing dams on fish and wildlife (contracted item)
- Classify wing dams according to physical and hydrological features (contracted item)
- Selection of short and long-term disposal sites
- Review literature concerning the creation of habitat with dredged materials
- Review literature regarding manipulation of water levels to benefit fish and wildlife resources
- Seed mudflats, in Pool 16, exposed by water level manipulation

Results and Conclusions: The results of the literature studies revealed: (1) the value of off-channel areas to fish and wildlife and the impacts of the 9-foot navigation project on fish and wildlife, (2) methods to improve or create habitat with dredge material, (3) impacts and benefits of water level manipulation on fish and wildlife. The interpretation of aerial surveys and the GREAT I SEWG report indicated the extent of habitat lost as a result of operation, and maintenance of the navigation channel.

The ongoing Fulton Flood Project will provide information on types of equipment, regulatory process impacts and benefits of dredging in backwaters.

Ongoing studies contracted by the work group may: (1) provide methods of constructing or altering wing dams to benefit fish and wildlife without affecting the navigability of the channel, (2) provide information on the effects of main channel dredging, disposal, navigation, etc., on fish, and (3) suggest studies to gain further information on impacts of the 9-foot channel on fish and wildlife or methods and measures to minimize these impacts. Selection of short and long-term disposal sites should minimize impacts of dredge disposal material on fish and wildlife.

Recommendations: To protect fish and wildlife resources during operation and maintenance of the nine-foot navigation channel, the FWMWG made 10 recommendations. Generally these are:

- FWMWG 3012 to include fish and wildlife resources as a project purpose of the nine-foot navigation project.
- FWMWG 3019 for the RID to eliminate all unwanted disposal of dredged material on federal and state management areas and refuges.
- FWMWG 3001 for the COE to obtain equipment which provides capability to dispose of dredged material on sites which preserve existing fish and wildlife habitat.
- FWMWG 3004 for the state and federal resource agencies to establish a fish and wildlife interagency committee to provide input into river management decisions and studies.

- FWMWG 3005 for the COE to mitigate past habitat losses caused by dredged material disposal.
- FWMWG 3007 for the RID to include fish and wildlife needs in training and revetment structure repair, alteration, or construction.
- FWMWG 3008 for the RID to determine means to reduce dredging at recurrent dredging sites.
- FWMWG 3009 for RID to evaluate the beneficial and adverse impacts of controlled water level fluctuations.
- FWMWG 3010 for RID to dispose of dredged material at 4 resource management areas.
- FWMWG 3040 for RID to evaluate possible modifications to backwaters that have habitat losses directly attributed to the navigation project.

A detailed discussion of these recommendations are contained in Section VIII. B. 2. of this report.

These recommendations encompass most problems associated with the RID O & M of the navigation project. The UMRBC Master Plan effort has proposed to carry this evaluation one step further by identifying the impacts of navigation on the UMR. Without this study no further recommendations can be made regarding O & M practices.

IX. C. PROBLEM 3

Problem: Information on the distribution of abundance of fish and wildlife resources is inadequate for many management decisions.

Was problem addressed? Yes.

Tasks:
- Literature search/review (contracted item)
- Study of use of main channel by fish (contracted item)
- Study of the effects of notching wing dams on aquatic resources (contracted item)
- Study to assess capability of obtaining submergent characteristics of the Mississippi River (contracted item)

Results and Conclusions: Literature review results are pending, however, it is expected numerous studies to improve our understanding of distribution and abundance will be suggested.

Main channel study results are pending, however, it is expected this study will illuminate our understanding of the value of this area to fish as well as suggest additional studies to gain further information.

The results of the study addressing effects of notching wing dams is still pending. It is expected this study will improve our knowledge of aquatic organisms using wing dams.

The results of the submergent characteristic study is pending. It is expected that utilization of this data will indicate suitable habitat for the various fish species of the Upper Mississippi River.

Recommendations: Numerous voids in information were identified. Therefore, the FWMWG made six recommendations to fill known voids. Generally, these are:

- FWMWG 3013 for the US FWS to obtain data regarding the submergent characteristics of the UMR.
- FWMWG 3026 for the UMRCC to develop and implement a detailed fish and wildlife monitoring plan.
- FWMWG 3024 for the US FWS to complete the Geographic Information System for the UMR.
- FWMWG 3014 for the US FWS to coordinate a colonial bird monitoring plan.
- FWMWG 3025 for the Iowa Conservation Commission to complete the wing dam study to ascertain relationships between biological and physical parameters of wing dams.
- FWMWG 3031 for the US FWS and the state resource agencies to develop habitat management techniques for threatened and endangered species.

A more detailed discussion of these recommendations may be found in Section VIII. B. 3. of this report.

It is likely that additional voids in information will be identified by two outstanding contracted studies. Appropriate recommendations may be made at that time.

IX. D. PROBLEM 4

Problem: There is a lack of ability to predict response of fish and wildlife to certain alterations of the environment.

Was the problem addressed? Yes.

Tasks:
- Review GREAT I and II SEWG side channel opening studies
- Literature search/review
- Provide input in selection of borrow and disposal sites for the Fulton Flood Control Project

Results and Conclusions: The side channel opening reports discuss the impacts/benefits to fish and wildlife of improving restoring of off-channel habitat.

The results of the literature review are pending. It is expected studies to gather information on the impacts of a wide variety of alterations will be suggested.

The Fulton Flood Control Project should provide information on the impacts/benefits of dredging slough and placement of overburden on river islands.

Recommendations: This problem and problems 3, 5, 6, 7 and 8 are interrelated as much information collected for the other problems will also address this problem. The FWMWG made three additional recommendations under this problem. Generally, these are:

- FWMWG 3029 for the RID to assess the cumulative impacts of riverine development.
- FWMWG 3027 for the RID to complete a habitat development project from silty dredged material and/or evaluate equipment to perform backwater alterations.
- FWMWG 3030 for the RID to monitor sites where dredged material is disposed in the next five years.

A more detailed discussion of these recommendations is found in Section VIII. B. 4. of this report.

Overall this problem can be interpreted as being very broad, and additional studies will probably be necessary as specific impacts or enhancement measures are identified.

IX. E. PROBLEM 5

Problem: Fish and wildlife are affected by industrial, recreational, agricultural, and municipal encroachment.

Was the problem addressed? Yes.

Tasks:
- Review literature concerning value of backwater to fish and wildlife
- Review historic and recent photographs of GREAT II study area
- Literature search/review (contracted item)
- Review literature regarding effects of encroachemnt on fish and wildlife
- Review literature regarding impacts of the 9-foot navigation channel on fish and wildlife
- Review literature concerning effects of commercial and recreational traffic on fish and wildlife

Results and Conclusions: The literature reviews provided (1) value of off-channel areas to fish and wildlife, (2) impacts of: municipal, agricultural, and industrial encroachment; creating recreation beaches; industrial growth to support navigation.

Review of historic and recent photos indicated the amount of habitat lost to agricultural, municipal, and industrial expansion, and the subsequent loss of agricultural lands to urban and industrial encroachment.

The results of the literature review are pending. It is expected, studies evaluating the impacts of encroachment on fish and wildlife will be suggested.

Recommendations: In order to address this problem, comprehensive planning is necessary. Therefore, the FWMWG made three recommendations to institute comprehensive planning on the UMR. Generally, these are:

- FWMWG 3039 for the Iowa Conservation Commission, Illinois Department of Conservation, and the US FWS to develop a comprehensive management plan for the fish and wildlife resources of Pool 19 (Keokuk Pool).
- FWMWG 3017 for all resource agencies to develop a comprehensive management plan for the fish and wildlife resources of the UMR.
- FWMWG 3016 for all agencies having an interest in the UMR to develop a comprehensive land use plan for the UMR cooridor

A more detailed discussion of these recommendations is found in Section VIII. B 5. of this report.

To completely address this problem and to develop comprehensive land use and management plans, additional information, studies, and data may be required that have not been recommended specifically by this work group. Some data gaps will be fulfilled by the UMRBC master planning effort, but others will be identified as the planning framework is established.

IX. F. Problem 6

Problem: Effluent from municipal, agricultural and industrial activities affect fish and wildlife resources.

Was the problem addressed? Yes.

Tasks:
- Literature search/review
- Review literature regarding effects of point/non-point source pollutants on fish and wildlife
- Review literature regarding effects of commercial and recreational boat traffic on fish and wildlife

Results and Conclusions: Literature reviews indicated that poor water quality due to point or non-point land sources and toxic spills from river traffic can seriously degrade fish and wildlife habitat.

Results of the literature review are pending. It is expected studies directed at gaining a better understanding of these problems will be suggested.

Recommendations: The major causes of adverse impacts to water quality were identified and five recommendations were made by the FWMWG. Generally, these are:

- FWMWG 3021 for the US FWS and state resource agencies to develop a contingency plan to protect fish and wildlife resource from spills of hazardous or toxic materials.
- FWMWG 3022 for all industries located in the floodplain, which produce or store toxic or hazardous materials to flood-proof their facilities.
- FWMWG 3037 for U.S. Coast Guard to complete and enforce regulations to protect the waters of the UMR from adverse spills.
- FWMWG 3038 for the U.S. Environmental Protection Agency to complete and enforce regulations to protect the waters of the UMR from adverse spills.
- FWMWG 3020 for the Federal Railroad Administration to direct railroads along the UMR to protect the river's waters from adverse spills.

For a more detailed discussion of these recommendations see Section VIII. B. 6. of this report.

Other sub-problems regarding the water quality of the UMR have been addressed by the GREAT II Water Quality Work Group and have been supported through the Plan Formulation Work Group process.

IX. G. PROBLEM 7

Problem: Fish and Wildlife are affected by commercial and recreational boat traffic.

Was the problem addressed? Yes.

Tasks: - Literature search/review
- Literature review to assess effects of commercial and recreational traffic on fish and wildlife

Results and Conclusions: The literature does not have extensive information on the effects of commercial and recreational traffic on fish and wildlife resources. However, several impacts are noted.

The results of the literature review are pending. It is expected a considerable number of studies in this area will be suggested.

Recommendations: To begin to address the impacts of navigation, the FWMWG made four recommendations. Generally, these are:

- FWMWG 3032 for the UMRBC master planning effort to identify the impacts of navigation and to develop a predictive model.
- FWMWG 3033 for the COE to identify and evaluate techniques to mitigate navigation-related impacts and to enhance the UMR resources.
- FWMWG 3023 for the RID to complete the biological studies necessary to complete the assessment of establishing year-round navigation or a closed navigation season.
- FWMWG 3034 for the RID to evaluate the impacts of barge fleeting on the study area.

A more detailed discussion of these recommendations is found in Section VIII. B. 7. of this report.

IX. H. PROBLEM 8

Problem: Discussion of lead shot issue.

Was problem addressed? No.

Significant research on this issue is being conducted. Findings are published and available to all. The work group did not believe additional work was necessary in this area.

Recommendations: None.

IX. I. PROBLEM 9

Problem: Devils Creek area should be maintained - There has been some discussion of stream straightening and development.

Was problem addressed? Yes.

The area is out of the study reach, however, information relating to this problem is discussed under Problem 5.

IX. J. PROBLEM 10

Problem: Fishing seems to be declining in the last few years.

Was problem addressed? Through Problems 1, 2, 5, 6 and 7.

IX. K. PROBLEM 11

Problem: Ducks disappearing on the river - all going to refuges instead of the river.

Was problem addressed? Through Problems 1, 2, 5, 6 and 7.

IX. L. PROBLEM 12

Problem: Fishing is not what it use to be.

Was the problem addressed? Yes through Problems 1, 2, 5, 6 and 7.

IX. M. PROBLEM 13

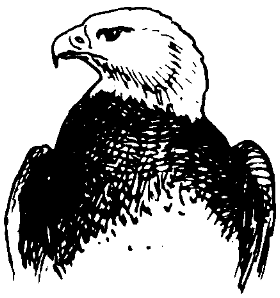
Problem: Need to preserve fish and wildlife that exists.

Was the problem addressed? Yes through Problems 1, 2, 3, 5, 6 and 7.

IX. N. PROBLEM 14

Problem: Drop off of fishing in the lower Des Moines River.

Was problem addressed? Yes through Problems 1, 2, 5, 6 and 7.



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APPENDIX 1

Freshwater Mussels of the Upper Mississippi River Drainage
and Distribution by Pool (since 1965)

Species	Pool 11	12	13	14	15	16	17	18	19	20	21	22
Spectacle Case (*Cumberlandia monodonta*)					X	X	X		X			
Monkey-face (*Quadrula metanevra*)	X	X	X	X	X	X	X	X	X	X	X	X
Mapleleaf (*Quadrula quadrula*)	X	X	X	X	X	X	X	X	X	X	X	X
Warty-back (*Quadrula nodulata*)	X	X	X	X	X	X	X	X	X	X	X	X
Pimple-back (*Quadrula pustulosa*)	X	X	X	X	X	X	X	X	X	X	X	X
Buckhorn (*Tritogonia verrucosa*)		X				X	X	X				
Purple Warty-back (*Cyclonaias tuberculata*)				X		X						
Pig-toe (*Fusconaia flava*)	X	X	X	X	X	X	X	X	X	X	X	X
Ebony Shell (*Fusconaia ebena*)				X	X	X	X					
Washboard (*Megalonaias gigantea*)	X	X	X	X	X	X	X	X	X	X		X
Three-ridge (*Amblema plicata*)	X	X	X	X	X	X	X	X	X	X	X	X
Bullhead (*Plethobasus cyphyus*)						X	X	X				
Pond-horn (*Uniomerus tetralasmus*)*												
Ohio Pigtoe (*Pleurobema cordatum*)												
Elephant ear (*Elliptio crassidens*)												
Spike (*Elliptio dilatata*)	X	X	X		X							
Threehorn (*Obliquaria reflexa*)	X	X	X	X	X	X	X	X	X	X	X	X
Pink heelsplitter (*Proptera alata*)	X	X	X	X	X	X	X	X	X			X
Pink paper shell (*Proptera laevissima*)	X	X	X	X	X	X	X	X	X	X		
Fat pocketbook (*Proptera capax*)												
Fragile paper shell (*Leptodea fragilis*)	X	X	X	X	X	X	X	X	X	X	X	X
Narrow paper shell (*Leptodea letodon*)												
Butterfly (*Plagiola* (=*Ellipsaria*) *lineolata*)	X	X	X	X	X	X	X	X	X	X	X	X
Deer Toe (*Truncilla truncata*)	X	X	X	X	X	X	X	X	X	X	X	
Fawn Foot (*Truncilla donaciformis*)	X	X	X	X	X	X	X	X	X	X	X	
Hickory nut (*Obovaria olivaria*)	X	X	X	X	X	X	X	X	X	X	X	X
Mucket (*Actinonaias carinata*)			X	X	X	X	X	X	X			
Ellipse (*Actinonaias ellipsiformis*)**		X										
Black Sandshell (*Ligumia recta*)	X	X	X	X	X	X	X	X	X	X		
Western Pondmussel (*Ligumia subrostrata*)												
Lilliput (*Carunculina parva*)	X		X		X	X			X			
Yellow Sandshell (*Lampsilis anodontoides* (=*teres*))				X	X		X		X	X	X	
Higgins' eye (*Lampsilis higginsi*)	X			X	X	X	X					
Fat Mucket (*Lampsilis radiata siliquoidea*)		X		X								
Pocketbook (*Lampsilis ovata ventricosa*)	X	X	X	X	X	X	X	X	X	X	X	X
Rainbow Shell (*Villosa iris*)*												
Snuffbox (*Dysnomia triquetra*)**												
Rock Pocketbook (*Arcidens confragosus*)	X	X	X	X	X	X	X	X	X	X	X	X
White Heelsplitter (*Lasmigona complanta*)	X	X	X	X		X	X		X	X		
Fluted Shell (*Lasmigona costata*)**												
Creek Heelsplitter (*Lasmigona compressa*)**					X							
Elktoe (*Alasmidonta marginata*)**												
Slipper-shell (*Alasmidonta calceolus*)												
Salamander Mussel (*Simpsoniconcha ambigua*)												
Cylindrical Paper Shell (*Anodontoides ferussacianus*)**						X						
Flat Floater (*Anodonta suborbiculata*)					X					X		
Paper Floater (*Anodonta imbecillis*)	X	X				X			X			
Floater (*Anodonta grandis*)	X	X	X	X	X	X	X	X	X	X		X
Squaw-foot (*Strophitis undulatus*)	X	X	X	X	X	X	X					

*Lives mainly in ponds or lakes; not usually found in streams.
**Lives mainly in small to medium streams.

APPENDIX 2

Distribution and Relative Abundance of Upper Mississippi River Fishes by Pools.*

Species	11	12	13	14	15	16	17	18	19	20	21	22	Overall
Chestnut lamprey (*Ichthyomyzon castaneus*)	R	R								O	O	O	O
Silver lamprey (*Ichthyomyzon unicuspis*)	O	O	O	O	O	O	O	O	O	O	O	O	O
Lake sturgeon (*Acipenser fulvescens*)	R					R	H		H	H	R	H	R
Shovelnose sturgeon (*Scaphirhynchus platorynchus*)	O	O	O	O	O	O	O	O	O	O	O	O	O
Paddlefish (*Polyodon spathula*)	O	C	C	C	C	C	C	C	C	C	C	C	C
Longnose gar (*Lepisosteus osseus*)	C	C	C	C	C	C	C	C	C	C	C	C	C
Shortnose gar (*Lepisosteus platostomus*)	C	C	C	C	C	C	C	C	C	C	C	C	C
Bowfin (*Amia calva*)	C	C	C	C	C	C	C	C	C	C	C	C	C
American eel (*Anguilla rostrata*)	O	O	O	O	O	O	O	O	O	O	O	O	O
Skipjack herring (*Alosa chrysochloris*)			H		O	O	O	O	O	O	O	O	O
Gizzard shad (*Dorosoma cepedianum*)	A	A	A	A	A	A	A	A	A	A	A	A	A
Goldeye (*Hiodon alosoides*)	H	U	H	H		U	U	U	O	C			U
Mooneye (*Hiodon tergisus*)	C	C	C	C	C	C	C	C	C	O			C
Rainbow trout (*Salmo gairdneri*)				X									X
Grass pickerel (*Esox americanus*)				X			X	X					X
Northern pike (*Esox lucius*)	O	O	O	O	O	O	O	O	O	O	O	O	O
Stoneroller (*Campostoma anomalum*)	X					X	H		X		X	X	X
Goldfish (*Carassius auratus*)										X			X
Carp (*Cyprinus carpio*)	A	A	A	A	A	A	A	A	A	A	A	A	A
Grass carp (*Ctenopharyngodon idella*)					O		O			O		O	O
Silvery minnow (*Hybognathus nuchalis*)	C	C	C	C									C
Speckled chub (*Hybopsis aestivalis*	C	C	C	C	C	C	C	C	C	C	C	C	C
Silver chub (*Hybopsis storeriana*)	C	C	C	C	C	C	C	C	C	C	C	C	C
Golden shiner (*Notemigonus crysoleucas*)	H	O	O	O	H	H	O	O	O	H	O		O
Pallid shiner (*Notropis amnis*)	H		R								H		R
Pugnose shiner (*Notropis anogenus*)		X											X
Emerald shiner (*Notropis atherinoides*)	A	A	A	A	A	A	A	A	A	A	A	A	A
River shiner (*Notropis blennius*)	A	A	A	A	A	A	A	A	A	A	A	A	A
Bigeye shiner (*Notropis boops*)								X			X		X
Ghost shiner (*Notropis buchanani*)	R	R	R	O	C	C	C	C	C	C	C	C	C
Common shiner (*Notropis cornutus*)	H												H
Bigmouth shiner (*Notropis dorsalis*)	O	O	O	O	O	O	O	O	O	O	O	O	O
Pugnose minnow (*Notropis emiliae*)	O	O	O	O	O	O	O	O					O
Spottail shiner (*Notropis hudsonius*)	C	C	C	C	C	C	C	C	C	C	C	C	C
Red shiner (*Notropis lutrensis*)								C	C	C	C	C	C
Rosyface shiner (*Notropis rubellus*)	X												X
Spotfin shiner (*Notropis spilopterus*)	C	C	C	C	C	C	C	C	O	O	O	O	C
Sand shiner (*Notropis stramineus*)	O	O	O	O	O	O	O	O	O	O	O	O	O
Weed shiner (*Notropis texanus*)	U	U											U
Redfin shiner (*Notropis umbratilis*)					X								X

Appendix 2 Continued.

Species	Pool Number 11	12	13	14	15	16	17	18	19	20	21	22	Overall
Mimic shiner (*Notropis volucellus*)	H												H
Suckermouth minnow (*Phenacobius mirabilis*)	U		U		U	U		U	U		U	U	U
Southern redbelly dace (*Phoxinus erythrogaster*)	X												X
Bluntnose minnow (*Pimephales notatus*)	O	O	O	O	O	O	O	O	O	O	O	O	O
Fathead minnow (*Pimephales promelas*)	U	U	U	U	U	U	U	U	U	U	U	U	U
Bullhead minnow (*Pimephales vigilax*)	A	A	A	A	A	A	A	A	A	A	A	A	A
Creek chub (*Semotilus atromaculatus*)	H												H
River carpsucker (*Carpiodes carpio*)	C	C	C	C	C	C	C	C	C	C	C	C	C
Quillback (*Carpiodes cyprinus*)	C	C	C	C	C	C	C	C	C	C	C	C	C
Highfin carpsucker (*Carpiodes velifer*)	O	O	O					U	U				O
White sucker (*Catostomus commersoni*)	C		X	X	X	X		X	X	X	X		X
Blue sucker (*Cycleptus elongatus*)	H			U	H	H			U	U	H		U
Northern hog sucker (*Hypentelium nigricans*)	R	R			X	X			X				X
Smallmouth buffalo (*Ictiobus bubalus*)	R	C	C	C	C	C	C	C	C	C	C	C	C
Bigmouth buffalo (*Ictiobus cyprinellus*)	C	C	C	C	C	C	C	C	C	C	C	C	C
Black buffalo (*Ictiobus niger*)	H	H	R	C	C	C	C	C	C	C	C	C	C
Spotted sucker (*Minytrema melanops*)	O	O	O	O	O	O	O	U					O
Silver redhorse (*Moxostoma anisurum*)	U	R	R	R	R	R	R	R	R	R			R
Golden redhorse (*Moxostoma erythrurum*)	U	U	U	R	R	R	R	R	R	R			R
Shorthead redhorse (*Moxostoma macrolepidotum*)	O	O	O	O	O	O	O	O	O	O	O	O	O
White catfish (*Ictalurus catus*)						X							X
Blue catfish (*Ictalurus furcatus*)			H	H	H	H	H	H	H	H	H	H	H
Black bullhead (*Ictalurus melas*)	O	O	O	O	O	O	O	O	O	O	O	O	O
Yellow bullhead (*Ictalurus natalis*)	O	O	O			O	O	O	O	O	O		O
Channel catfish (*Ictalurus punctatus*)	C	C	C	C	C	C	C	C	C	C	C	C	C
Stonecat (*Noturus flavus*)	H		U			H				O	O		U
Tadpole madtom (*Noturus gyrinus*)	U	U	U	U					U		H		U
Freckled madtom (*Noturus nocturnus*)										U	U		U
Flathead catfish (*Pylodictis olivaris*)	C	C	C	C	C	C	C	C	C	C	C	C	C
Pirate perch (*Aphredoderus sayanus*)	H												H
Trout-perch (*Percopsis omiscomaycus*)								U					U
Burbot (*Lota lota*)	H					R							R
Blackstripe topminnow (*Fundulus notatus*)							U	U		O	O	O	O
Mosquitofish (*Gambusia affinis*)											X		X
Brook silverside (*Labidesthes sicculus*)	C	C	C	C	C	C	C	C	O	O	O	O	C
Brook stickleback (*Culaea inconstans*)		X											X
White bass (*Morone chrysops*)	C	C	C	C	C	C	C	C	C	C	C	C	C
Yellow bass (*Morone mississippiensis*)	O	O	O	O	O	O	O	O	O	O	O	O	O
Rock bass (*Ambloplites rupestris*)	R	O	R	R	R	R	R	R	R	R	R	R	R
Green sunfish (*Lepomis cyanellus*)	O	O	O	O	O	O	O	O	O	O	O	O	O
Pumpkinseed (*Lepomis gibbosus*)	C	C	C	C		H	H	U	H				U
Warmouth (*Lepomis gulosus*)	U	U	U	U		U	U	U	U		U	U	U
Orangespotted sunfish (*Lepomis humilis*)	C	C	C	C	C	C	C	C	C	C	C	C	C

Appendix 2 Continued.

Species	11	12	13	14	15	16	17	18	19	20	21	22	Overall
	Pool Number												
Bluegill (*Lepomis macrochirus*)	A	A	A	A	A	A	A	A	A	A	A	A	A
Redear sunfish (*Lepomis microlophus*)									X				X
Smallmouth bass (*Micropterus dolomieui*)	U	U	U	U	U	U	U	R	R	R	R	R	U
Largemouth bass (*Micropterus salmoides*)	C	C	C	C	C	C	C	C	C	C	C	C	C
White crappie (*Pomoxis annularis*)	C	C	C	C	C	C	C	C	C	C	C	C	C
Black crappie (*Pomoxis nigromaculatus*)	C	C	C	C	C	C	C	C	C	C	C	C	C
Crystal darter (*Ammocrypta asprella*)	H												H
Western sand darter (*Ammocrypta clarki*)	O	O	O	O	O	O	O	O	O	O	O	O	O
Mud darter (*Etheostoma asprigene*)	H		O										U
Fantail darter (*Etheostoma flabellare*)	H												H
Johnny darter (*Etheostoma nigrum*)	U	U	U	U	U	U		U	U		U	U	U
Banded darter (*Etheostoma zonale*)	X												X
Yellow perch (*Perca flavescens*)	C	O	O	O	O	O	O	O	O			H	O
Logperch (*Percina caprodes*)	C	C	C	C	C	C	C			O	O	O	C
Slenderhead darter *Percina phoxocephala*)	H									R	R		R
River darter (*Percina shumardi*)	C	C	C	C	C	C	C	C	C	C	C	C	C
Sauger (*Stizostedion canadense*)	C	C	C	C	C	C	C	C	C	C	C	C	C
Walleye (*Stizostedion vitreum*)	C	C	C	C	C	C	C	C	C	C	O	O	C
Freshwater drum (*Aplodinotus grunniens*)	C	C	C	C	C	C	C	C	C	C	C	C	C

Key to the Status of a Species:

- X - Probably occurs in the pool only as a stray from a tributary water.
- H - Records of occurrence are available for this pool, but the species has not been recorded in UMRCC collections in the last ten years.
- R - Considered to be rare in this pool. Some species in this category may be on the verge of extirpation.
- U - Uncommon, does not usually appear in sample collections, populations are small, but the species in this category do not appear to be on the verge of extirpation.
- O - Occasionally collected, not generally distributed, and local concentrations may occur.
- C - Commonly taken in most sample collections through the pool, can make up a large portion of some samples.
- A - Abundantly taken in all river surveys.

* Mississippi River pools are numbered according to U.S. Army, Corps of Engineers nomenclature in which a pool carries the same number as the dam which has impounded it.

APPENDIX 3

Relative Seasonal Abundance of Birds of the GREAT II Study Area

Birds	Spring	Summer	Fall	Winter
Common Loon	R		R	O
Red-necked Grebe	R		R	
Horned Grebe	R,O		R,O	O
Pied-billed Grebe	C	C,U	C	U
White Pelican	O	R	O,R	
Double-crested Cormorant*	C,U**	C,U**	C,U**	
Great Blue Heron*	C	C	C	R
Green Heron*	C	C	C	
Little Blue Heron	U**	R,C**	U**	
Cattle Egret	U	U**	R,U**	
Great Egret (Common Egret)*	C	C	O	
Snowy Egret	R	R,U**		
Black-crowned Night Heron*	C	C	C	
Yellow-crowned Night Heron*	U,C**	U,U**	U,U**	
Least Bittern*	O,U**	O,U**	O	
American Bittern*	C	C,U**	C	
Whistling Swan	C,O**	R**	C	
Canada Goose*	C	O	C	O
White-fronted Goose	R,U**		R	
Snow Goose (White Morph)	U,C**		U,C**	O**
Snow Goose (Blue Morph)	U,C**		U,C**	O**
Mallard*	A	C	A	C
Black Duck*	C	O	C	O
Gadwall	C		C	
Pintail	A	R	A	R
Green-winged Teal*	C	R	C	R,O**
Blue-winged Teal*	A	U	A	
American Wigeon	A		A	
Northen Shoveler	C	O**	C	O**
Wood Duck*	C	C	C	O**
Redhead	C	O	C	R
Ring-necked Duck	A		A	R
Canvasback	C		C	
Greater Scaup	A,R**		A,R**	
Lesser Scaup	A	R	A	R
Common Goldeneye	C		C	O
Bufflehead	O		O	R
Oldsquaw	R		R	R
White-winged Scoter	R		R	R
Black Scoter (Common Scoter)	R**		R	R
Surf Scoter	R		R	
Ruddy Duck	C	R	C	R**
Hooded Merganser*	C	O	C	
Common Merganser	C		C	
Red-breasted Merganser	R		R	R
Turkey Vulture	O	O	O	R
Goshawk	R**			O
Sharp-shinned Hawk	U	U	U	O
Cooper's Hawk	U	U	U	O
Red-tailed Hawk*	C	C	C	C
Red-shouldered Hawk*	O	O	O	U
Swainson's Hawk	R**		R	
Broad-winged Hawk*	O	O	O**	

Appendix 3 Continued.

Birds	Spring	Summer	Fall	Winter
Rough-legged Hawk	R**		O	O
Golden Eagle	R		R	R
Bald Eagle*	O	O	O	C
Marsh Hawk*	C	C	C	O
Osprey	O	O	O	O
Peregrine Falcon	R	R	R,O**	
Merlin (Pigeon Hawk)	R,O**		R,O**	
American Kestrel (Sparrow Hawk)*	O	O	O	R
Ruffed Grouse*	C	C	C	C
Bobwhite*	O	O	O	O
Ringed-necked Pheasant*	C	C	C	C
Gray Partridge*	O	O	O	O
Turkey	O	O	O	O
King Rail*	U	U		
Virginia Rail*	U	U	O	
Sora*	A	A	C	
Common Gallinule*	R	R		
American Coot*	A	C	A	R
Semipalmated Plover	C	O	C	
Killdeer*	C	C	C	R
American Golden Plover	O		U	
Black-bellied Plover	O		O	
Ruddy Turnstone	R			
American Woodcock*	R,O**	R	R,C**	
Common Snipe	C	O	C	R
Upland Sandpiper (Upland Plover)*	O	O	O**	
Spotted Sandpiper*	C	C	C	
Solitary Sandpiper	C	C**	C	
Willet	R		R	
Greater Yellowlegs	U	O**	U	
Lesser Yellowlegs	A	O	A	
Pectoral Sandpiper	O	O	O	
White-rumped Sandpiper	O		O	
Baird's Sandpiper	O	O	O	
Least Sandpiper	C	O	C	
Western Sandpiper	O**	O**	O**	
Dunlin	O	O	O	
Short-billed Dowitcher	U	U	U	
Long-billed Dowitcher	O	U**	O	
Stilt Sandpiper	O	O	O	
Semipalmated Sandpiper	C	C	C	
Marbled Godwit	R			
Hudsonian Godwit	R			
Sanderling	O	O	O	
Avocet	R	R		
Wilson's Phalarope	O	O	O	
Northern Phalarope	O		O	
Herring Gull	C	O	C	U
Ring-billed Gull	C	O	C	U
Franklin's Gull	O		O	
Bonaparte's Gull	U		U	
Forster's Tern	C	O	C	
Common Tern	C	O	C	

Appendix 3 Continued.

Birds	Spring	Summer	Fall	Winter
Caspian Tern	O	U**	O	
Black Tern	C	C	O	
Rock Dove*	C	C	C	C
Mourning Dove*	C	C	C	O
Yellow-billed Cuckoo*	C	C		
Black-billed Cuckoo*	C	C		
Screech Owl*	C	C	C	C
Great Horned Owl*	C	C	C	C
Snowy Owl				O
Barred Owl*	C	C	C	C
Long-eared Owl*	U	U	U	U
Short-eared Owl*	U	U	U	U
Saw-whet Owl*	U	U	U	U
Whip-poor-will*	C	C		
Common Nighthawk*	A	A	O	
Chimney Swift*	A	A		
Ruby-throated Hummingbird*	C	C		
Belted Kingfisher*	C	C	O	U
Common Flicker (Yellow-shafted)*	C	C	C	U
Pileated Woodpecker*	O	O	O	O
Red-bellied Woodpecker*	C	C	C	C
Red-headed Woodpecker*	C	C	C	R
Yellow-bellied Sapsucker*	C		C	
Hairy Woodpecker*	C	C	C	C
Downy Woodpecker*	C	C	C	C
Eastern Kingbird*	A	C**	R**	
Great Crested Flycatcher*	C	C	R**	
Eastern Phoebe*	C	C	O	
Yellow-bellied Flycatcher	U	U	U	
Acadian Flycatcher	O	O		
Alder Flycatcher (Traill's)	C	C	O	
Willow Flycatcher (Traill's)*	C	C	U	
Least Flycatcher*	A	A	U	
Eastern Wood Pewee*	C	C	U	
Olive-sided Flycatcher	O	O		
Horned Lark*	C	C	C	O
Tree Swallow*	A	A	U	
Bank Swallow*	C	C	U	
Rough-winged Swallow*	O	O	U**	
Barn Swallow*	A	A	U	
Cliff Swallow*	O	O	U	
Purple Martin*	A	A	U	

Appendix 3 Continued.

Birds	Spring	Summer	Fall	Winter
Blue Jay*	C	C	C	C
Common Crow*	A	A	A	O
Blacked-capped Chickadee*	C	C	C	C
Tufted Titmouse*	C	C	C	C
White-breasted Nuthatch*	C	C	C	C
Red-breasted Nuthatch				R
Brown Creeper	C	R**	C	O
House Wren*	A	A	O	
Winter Wren	O	R**	O	O**
Bewick's Wren	O	R**	O	
Carolina Wren	O	O	O	
Long-billed Marsh Wren*	C	C	C**	
Short-billed Marsh Wren*	O	O	O**	
Mockingbird	R,C**	R,C**	C**	
Grey Catbird*	C	C	O	
Brown Thrasher*	C	C	O	
American Robin*	C	C	C	R
Wood Thrush*	C	C	C	
Hermit Thrush	C		C	
Swainson's Thrush	C,U**	U**	C	
Gray-cheeked Thrush	C,U**	U**	C	
Veery	C		C	
Eastern Bluebird*	C,U**	C,U**	C,U**	R,U**
Blue-gray Gnatcatcher*	U,C**	U,C**		
Golden-crowned Kinglet	O,U**		O,U**	O
Ruby-crowned Kinglet	C,U**	U**	C	
Water Pipit	U		U	
Bohemian Waxwing				O,R**
Cedar Waxwing*	C	C	C	O
Northern Shrike	R		O,R**	O,R**
Loggerhead Shrike*	C	C	C	R**
Starling*	A	A	A	A
White-eyed Vireo	C	C	R**	
Bell's Vireo*	U	U		
Yellow-throated Vireo*	C	C	C	
Solitary Vireo	O	O**	O	
Red-eyed Vireo*	C	C	O	
Philadelphia Vireo	U	O**	U	
Warbling Vireo	A	A	A	

Appendix 3 Continued.

Birds	Spring	Summer	Fall	Winter
Black-and-white Warbler	C	O**	C	
Prothonotary Warbler*	C	C		
Blue-winged Warbler*	O	O		
Golden-winged Warbler	O	O	U	
Tennesse Warbler	C		C	
Orange-crowned Warbler	O		O	
Nashville Warbler	O		O	
Northern Parula	U		U	
Yellow Warbler*	A	A	O	
Magnolia Warbler	C		C	
Cape May Warbler	O		O	
Black-throated Blue Warbler	O		O	
Yellow-rumped Warbler (Myrtle)	A		A	
Black-throated Green Warbler	C		C	
Cerulean Warbler*	R			
Blackburnian Warbler	C		C	
Chestnut-sided Warbler	O		O	
Bay-Breasted Warbler	O		O	
Blackpoll Warbler	C		C	
Pine Warbler	O		O	
Palm Warbler	C		C	
Ovenbird*	O	O	O	
Northern Waterthrush	C		C	
Louisiana Waterthrush*	O	O	O	
Kentucky Warbler*	R	R		
Connecticut Warbler	R		R	
Mourning Warbler	O		O	
Common Yellowthroat*	A	A	O	
Yellow-breasted Chat*	R,O**	R,O**	O**	
Hooded Warbler	R	R		
Wilson's Warbler	C		C	
Canada Warbler	C		C	
American Redstart*	A	A	A	
House Sparrow*	A	A	A	A
Bobolink*	O	O	O	
Eastern Meadowlark*	C	C	C	O
Western Meadowlark*	O	O	O	O
Yellow-headed Blackbird*	O	O	O	
Red-winged Blackbird*	A	A	A	A
Orchard Oriole*	U,C**	U,C**	O**	
Northern Oriole (Baltimore)*	C	C	O**	
Rusty Blackbird	C		C	O
Brewer's Blackbird*	U	O	U	R
Common Grackle*	A	A	A	U
Brown-headed Cowbird*	A	A	U	R
Scarlet Tanager*	O	O	O	
Cardinal*	C	C	C	C
Rose-breasted Grosbeak*	C	C		
Indigo Bunting*	C	C	O	
Dickcissel	C	C	O**	
Evening Grosbeak	R**			O
Purple Finch	O		O	O
Pine Grosbeak			R	R
Hoary Redpoll				R
Common Redpoll				U

Appendix 3 Continued.

Birds	Spring	Summer	Fall	Winter
Pine Siskin	O		O	O
American Goldfinch*	A	A	A	C
Red Crossbill				R
White-winged Crossbill	R			R
Rufous-sided Towhee*	A	A	A	C
Savannah Sparrow*	O	O	O	
Grasshopper Sparrow*	O	O	O	
Henslow's Sparrow*	R	R	U	
Le Conte's Sparrow	U	U	U	
Vesper Sparrow*	O	O		
Lark Sparrow*	O	O		
Dark-eyed Junco (Slate-colored Oregon)	C		C	C
Tree Sparrow	C	O**	A	A
Chipping Sparrow*	A	A	A	
Clay-colored Sparrow	U	U	U	
Field Sparrow*	C	C	C	R
Harris' Sparrow	C		C	O**
White-crowned Sparrow	O	O**	O	R,O**
White-throated Sparrow	A		A	R,U**
Fox Sparrow	O	O**	O	O**
Lincoln's Sparrow	C	O**	C	O**
Swamp Sparrow*	C	C	O	
Song Sparrow*	A	A	C	R,C**
Lapland Longspur	O		O	O
Snow Bunting				U

* - nests in the study area
** - abundance for lower portions of the study area

A - abundant (present in large numbers)
C - common (certain to be seen but seldom in large numbers)
U - uncommon (present in smaller numbers or not always seen)
O - occasional (seldom seen, present in most years)
R - rare (present only in some years)

APPENDIX 4

Relative Abundance of Upper Mississippi River Mammals

Scientific Name	Common Name	Occurrence
Marsupialia		
Didelphis virginiana	Virginia Opposum	Common
Insectivora		
Scalopus aquaticus	Eastern Mole	Common
Sorex cinereus	Masked Shrew	Rare
Cryptotis parva	Least Shrew	Common
Blarina brevicauda	Short-Tailed Shrew	Common
Chiroptera		
Myotis keenii	Keen's Myotis	Common
Myotis lucifugus	Little Brown Myotis	Common
Myotis sodalis	Indiana Bat	Rare
Myotis subulatus	Least Myotis	Rare
Lasionycteris noctivagans	Silver-Haired Bat	Rare
Pipistrellus subflavus	Eastern Pipistrel	Rare
Eptesicus fuscus	Big Brown Bat	Common
Lasiurus borealis	Red Bat	Common
Lasiurus cinereus	Hoary Bat	Rare
Nycticeius humeralis	Evening Bat	Rare
Lagomorpha		
Sylvilagus floridanus	Eastern Cottontail	Common
Lepus townsendii	White-Tailed Jackrabbit	Rare
Rodentia		
Marmota monax	Woodchuck	Common
Spermophilus tridecemlineatus	Thirteen-Lined Ground Squirrel	Common
Spermophilus franklinii	Franklin's Ground Squirrel	Rare
Tamias striatus	Eastern Chipmunk	Common
Sciurus carolinensis	Gray Squirrel	Common
Sciurus niger	Fox Squirrel	Common
Glaucomys volans	Southern Flying Squirrel	Common
Geomys bursarius	Plains Pocket Gopher	Common
Castor canadensis	Beaver	Common
Reithrondontomys megalotis	Western Harvest Mouse	Common
Peromyscus leucopus	White-Footed Mouse	Common
Peromyscus maniculatus	Deer Mouse	Common
Synaptomys cooperi	Southern Bog Lemming	Rare
Macrotus pennsylvanicus	Meadow Vole	Common
Microtus ochrogaster	Prairie Vole	Common
Microtus pinetorum	Woodland Vole	Rare
Ondatra zibethicus	Muskrat	Common
Myocaster coypus	Nutria	Rare
Mus musculus	House Mouse	Common
Rattus norvegicus	Norway Rat	Common
Zapus hudsonius	Meadow Jumping Mouse	Rare
Carnivora		
Canis latrans	Coyote	Common
Vulpes vulpes	Red Fox	Common
Urocyon cinereoargenteus	Gray Fox	Common
Procyon lotor	Raccoon	Common
Mustela erminea	Ermine	Rare
Mustela frenata	Long-Tailed Weasel	Common
Mustela nivalis	Least Weasel	Rare
Mustela vison	Mink	Common
Taxidea taxus	Badger	Rare
Lutra canadensis	River Otter	Rare
Mephitis mephitis	Striped Skunk	Common
Spilogale putorius	Spotted Skunk	Rare
Felis rufus	Bobcat	Rare
Artiodactyla		
Odocoileus virginianus	White-Tailed Deer	Common

APPENDIX 5

Relative Abundance of Amphibians and Reptiles of the GREAT II Study Area

Common Name	Scientific Name	Occurrence
Salamanders		
Mudpuppy	*Necturus m. maculosus*	Common
Central Newt	*Notopthalmus viridescens louisianensis*	Rare
Spotted Salamander	*Ambystoma maculatum*	Rare
Smallmouth Salamander	*Ambystoma texanum*	Uncommon
Eastern Tiger Salamander	*Ambystoma t. tigrinum*	Common
Dark-sided Salamander	*Eurycea longicauda melanopleura*	Common
Four-toed Salamander	*Hemidactylum scutatum*	Rare
Frogs and Toads		
American Toad*	*Bufo americanus*	Uncommon
Fowler's Toad	*Bufo woodhousei fowleri*	Abundant
Northern Spring Peeper	*Hyla crucifer crucifer*	Common
Gray Tree Frog	*Hyla versicolor*	Common
Blanchard's Cricket Frog	*Acris crepitans blanchardi*	Common
Western Chorus Frog	*Pseudacris t. triseriata*	Varied
Pickerel Frog	*Rana palustris*	Common
Northern Leopard Frog	*Rana pipiens*	Common
Southern Leopard Frog	*Rana sphenocephala*	Common
Northern Crawfish Frog	*Rana areolata circulosa*	Uncommon
Green Frog	*Rana clamitans melanota*	Varied
Wood Frog	*Rana sylvatica*	Uncommon
Bullfrog	*Rana catesbeiana*	Common
Turtles		
Alligator Snapping Turtle	*Macroclemys temmincki*	Very rare
Common Snapping Turtle	*Chelydra s. serpentina*	Common
Stinkpot	*Sternotherus odoratus*	Uncommon
Illinois Mud Turtle	*Kinosternon flavescens spooneri*	Very rare
Blanding's Turtle	*Emydoidea blandingi*	Very rare
Eastern Box Turtle	*Terrapene c. carolina*	Uncommon
Ornate Box Turtle	*Terrapene o. ornata*	Uncommon
Western Painted Turtle	*Chrysemys picta belli*	Abundant
Red-eared Slider	*Chrysemys scripta elegans*	Varied
False Map Turtle	*Graptemys p. pseudogeographica*	Uncommon
Map Turtle	*Graptemys geographica*	Common
Smooth Softshell	*Trionyx muticus*	Uncommon
Eastern Spiny Softshell	*Trionyx spiniferus*	Common
Lizards		
Western Slender Glass Lizard	*Ophisaurus a. attenuatus*	Uncommon
Six-lined Racerunner	*Cnemidophorus s. sexlineatus*	Varied
Five-lined Skink	*Eumeces fasciatus*	Uncommon
Broad-headed Skink	*Eumeces laticeps*	Varied
Snakes		
Western Worm Snake	*Carphophis amoenus vermis*	Uncommon
Prairie Ringneck Snake	*Diadophis punctatus arnyi*	Common
Plains Hognose Snake	*Heterodon n. nasicus*	Uncommon
Eastern Hognose Snake	*Heterodon platyrhinos*	Common
Western Smooth Green Snake	*Opheodrys vernalis blanchardi*	Rare
Blue Racer	*Coluber constrictor flaviventris*	Common
Black Rat Snake	*Elaphe o. obsoleta*	Uncommon
Western Fox Snake	*Elaphe v. vulpina*	Uncommon
Bullsnake	*Pituophis melanoleucus sayi*	Uncommon
Prairie Kingsnake	*Lampropeltis c. calligaster*	Uncommon
Speckled Kingsnake	*Lampropeltis getulus holbrooki*	Rare
Milk Snake*	*Lampropeltis triangulum*	Uncommon
Western Ribbon Snake	*Thamnophis p. proximus*	Common
Eastern Plains Garter Snake	*Thamnophis r. radix*	Rare
Eastern Garter Snake	*Thamnophis s. sirtalis*	Common
Midland Brown Snake	*Storeria dekayi wrightorum*	Common
Northern Red-bellied Snake	*Storeria o. occiptomaculata*	Uncommon
Copperbelly Water Snake	*Nerodia erythrogaster neglecta*	Uncommon
Graham's Water Snake	*Regina grahami*	Common
Diamondbacked Water Snake	*Nerodia r. rhombifera*	Common
Northern Water Snake*	*Nerodia sipedon*	Common
Northern Copperhead	*Agkistrodon contortrix mokeson*	Varied
Eastern Massasauga	*Sistrurus c. catenatus*	Uncommon
Timber Rattlesnake	*Crotalus horridus*	Common

* represented in GREAT II area by two subspecies.

APPENDIX 6

Estimated Small Game Mammal Harvest and Hunter Use Days for the Study Area

State	Rabbit		Squirrel		Woodchuck	
	Harvest	Hunter Days	Harvest	Hunter Days	Harvest	Hunter Days
Iowa	73,423	No Data	27,858	No Data	No Data	No Data
Illinois	86,216	72,810	107,554	91,945	No Data	No Data
Missouri	25,436	16,305	24,587	15,178	171	387
Wisconsin	500	No Data	400	No Data	No Data	No Data
Total	186,000	89,000	160,000	107,000	170	390

APPENDIX 7

Deer Harvest and Hunter Use in the Study Area

State	Harvest*	Hunted Days
Iowa	728	14,725
Illinois	1,523	No Data
Missouri	881	14,991
Wisconsin	5	110
Total	3,000	30,000

* This total may include bow hunters and firearms hunters.

APPENDIX 8

Estimated Upland Game Bird Harvest and Hunter Use Days for the Study Area

State	Bobwhite		Mourning Dove		Pheasant		Wild Turkey	
	Harvest	Hunter Days	Harvest	Hunter Days	Harvest	Hunter Days	Harvest	Hunter Days
Iowa	50,478	No Data	No Data	No Data	55,911	No Data	No Data	No Data
Illinois	30,320	39,385	50,711	18,330	15,075	36,058	No Data	No Data
Missouri	14,498	6,992	11,777	4,324	No Data	No Data	78	1,355
Wisconsin	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Total	95,000	46,000	62,000	23,000	71,000	36,000	80	1,350

APPENDIX 9

Annual Hunter Days Afield
and Waterfowl Harvest in the Study Area

State	Harvest: Ducks	Harvest: Geese	Hunter Days
Iowa	65,060	3,219	No Data (119,000)*
Illinois	39,173	1,431	80,883
Missouri	4,117	202	578
Wisconsin	4,080	4	4,250
Total	112,000	5,000	86,000 (205,000)

* No specific hunter days data available from Iowa. However, based on the success-rate in the rest of the study area, it is assumed that 119,000 days were spent afield in Iowa.

APPENDIX 10

Estimated Fur Harvest and Pelt Values for the Study Area *

State	Opossum	Skunk	Muskrat	Raccoon	Mink	Fox	Beaver	Coyote	Man-Days
Iowa	No Data	No Data	No Data	23,148	No Data	1,345	No Data	3,061	No Data
Illinois	1,625	417	11,551	36,895	354	1,734	64	3,348	92,022
Missouri	301	15	644	6,599	14	Season Closed	14	183	7,116
Wisconsin	5	No Data	17,587	225	32	2	35	No Data	3,935
Total	1,900	400	30,000	67,000	400	3,100	110	6,600	103,000
Average Price/Pelt	$2.05	$2.15	$4.75	$18.59	$12.71	$39.37	$6.81	$17.44	-
Value of	$3,900	$900	$141,000	$1,243,000	$5,000	$121,000	$700	$115,000	-

* Harvest of raccoon, fox, coyote includes animals listed by states under hunting harvest.

APPENDIX 11

Codes For Reasons For Decline of Endangered Species

A. Habitat Loss

1. Woody riparian, bottomlands
2. Shallow aquatic areas
3. Deep hardwood forest
4. Open grassy areas, prairie
5. Coniferous forest
6. Bogs
7. Small lakes
8. Open beaches
9. Caves
10. Cliffs, wooded bluffs

B. Habitat Degradation

1. Pesticide poisoning
2. Changes in water quality
3. Proximity to development
4. General agricultural practices
5. Construction of navigational structures
6. Physical changes in streams

C. Exploitation

1. Sporting use
2. Commercial use
3. Harassment
4. Private collecting

D. Inherent Rarity

1. Historical rarity
2. Range periphery
3. Cyclical populations

E. Unknown

APPENDIX 12

Federally Endangered and Threatened Species within GREAT II Study Area

Common Name/Scientific Name	Status	Habitat	Reasons for Decline*	Projection
Indiana Bat *Myotis sodalis*	E	Caves, floodplain woods in summer	A9 - C3 - D4 - B1	Decline; stable possible, with protection
Gray Bat *Myotis grisescens*	E	Warm caves	E Possibly A9 - B1	Stable at low levels, with protection
Bald Eagle *Haliaeetus leucocephalus*	E	Forested areas near large bodies of water	A1 - B1	Stable
American Peregrine Falcon *Falco peregrinus anatum*	E	Bluffs or cliffs	B1 - A10 - C2	Stable at very low levels as migrant
Artic Peregrine Falcon *Falco peregrinus tundrius*	E	Bluffs or cliffs	B1	Stable at very low levels as migrant
Higgins' Eye Pearly Mussel *Lampsilis higginsi*	E	Deep water areas of large rivers	B2 - B6	Continued decline
Fat Pocketbook *Potamilus capax*	E	Sand and mud bottom on large rivers at depths of a few inches to 8 feet or more	B2 - B6	Continued decline
Northern Wild Monkshood *Aconitum novaboracense*	T	Rich woods, shaded ravines; steep talus slopes	C4 - A3	Possible stable in isolated locations

* See Appendix 11 codes for reasons for decline.

APPENDIX 13

Endangered and Threatened Species of Illinois within the GREAT II Study Area

Common Name/Scientific Name	Status	Habitat	Reasons for Decline*	Projection
River Otter *Lutra canadensis*	T	Vegetated banks of larger streams	B2 - C1 - B4	Continued decline
Indiana Bat *Myotis sodalis*	E	Caves; floodplain woods in summer	A9 - C3 - D4 - B1	Decline; possible stable at low levels with protection
Gray Bat *Myotis grisescens*	E	Warm caves	E - possibly A9 - B1	With protection, stable at low levels
Bobcat *Lynx rufus*	T	Wooded areas along rivers, especially bluffs	A3 - A10 - C3	Decline to very low levels
Cooper's Hawk *Accipiter cooperii*	E	Open woodlands and wood margins	A3 - C3 - B3	Continued decline
Red-shouldered Hawk *Buteo lineatus*	E	Swamps, river bottoms	A1 - C3 Competition with Red-tailed Hawk	Decline to stable at low levels
Swainson's Hawk *Buteo swainsoni*	E	Open areas	D1 - D2	Continued decline
Marsh Hawk *Circus cyaneus*	E	Marshes; open areas	A2 - A4	Continued decline
Peregrine Falcon *Falco peregrinus*	E	Bluffs or cliffs	B1 - A10 - C2	Stable at low levels as migrant; possibility of re-introduction of nesting individuals
Bald Eagle *Haliaeetus leucocephalus*	E	Wooded areas near large bodies of water	A1 - B3	Stable as migrant
Osprey *Pandion haliaetus*	E	Extensive bodies of clear water, elevated nesting sites	B1 - C3 - B2 - A1	Continued decline
Barn Owl *Tyto alba*	E	Open country, usually near buildings	Loss of old buildings as nesting/roosting sites	Continued decline
Long-eared Owl *Asio otus*	E	Forested areas, evergreens preferred for communal winter roosts	E - Possibly D2 A4	Continued decline
Short-eared Owl *Asio flammeus*	E	Open grasslands, marshes, dunes	A4 - D2	Continued decline
Wilson's Phalarope *Steganopus tricolor*	E	Prairie sloughs or ponds	A1 - A2 - D2	Continued sharp decline

* See Appendix 11 codes for reasons for decline

Appendix 13 Continued.

Common Name/Scientific Name	Status	Habitat	Reasons for Decline*	Projection
Common Gallinile *Gallinula chloropus*	T	Moderately deep cattail marshes with many openings	A2	Continued decline
Yellow Rail *Coturnicops noveboracensis*	E	Tall grass marshes and wet meadows	A2	Continued decline
Black Rail *Laterallus jamaicensis*	E	Marshes	A2	Continued sharp decline
Black-crowned Night Heron *Nycticorax nycticorax*	E	Extensive marshes preferred, trees for roosting	A1 - A2 - B2	Continued decline
Great Egret *Casmerodius albus*	E	Feeds in ponds, marshes, sluggish streams; roosts in trees; nests in swamp woods or willow thickets	A2 - B2	Stable at low levels
Double-crested Cormorant *Phalacrocorax auritus*	E	Lakes or rivers	A1 - C3 - B1 - B3	Continued sharp decline
Upland Sandpiper *Bartramia longicauda*	E	Open grassy areas especially rich pasture-land and hay fields	A4	Continued decline
Forster's Tern *Sterna forsteri*	E	Marshes	A2	Continued decline; low levels as migrant
Yellow-headed Blackbird *Xanthocephalus xanthocephalus*	E	Marshes and sloughs	A2	Continued decline; stable as migrant
Veery *Catharus fuscescens*	T	Wooded areas with dense undergrowth	A3	Continued decline
Brown Creeper *Certhia familiaris*	E	Mature forests; other wooded areas	A1 - A5 - D3	Stable at low levels
Henslow's Sparrow *Ammodramus henslowii*	E	Open grasslands with rank vegetation; particularly wet areas	A4	Stable at very low levels
Illinois Mud Turtle *Kinosternon flavescens*	E	Sand prairie	A2 - A4 - B2 - C4 D2	Continued decline
Western Hognose Snake *Heterodon nasicus*	T	Sand prairies and adjacent open woodlands	A4	Continued decline
Lake Sturgeon *Acipenser fulvescens*	T	Large rivers and lakes	B2	Continued decline

* See Appendix 11 codes for reasons for decline

APPENDIX 14

Endangered and Threatened Species of Iowa in the GREAT II Study Area

Common Name/Scientific Name	Status	Habitat	Reasons for Decline*	Projection
Indiana Bat *Myotis sodalis*	E	Caves; floodplain woods in summer	A9 - C3 - D4 - B1	Decline; possibly stable at very low levels with protection
Keen's Myotis *Myotis keenii*	T	Caves, abandoned mines, buildings	E - Possibly A9	Possibly stable at low levels
Evening Bat *Nycticeius humeralis*	T	Buildings and woodlands with hollow trees	D1 - D2 - loss of nursery sites	Stable, possible decline
Black Bear *Ursus americana*	E	Extensive forests and swamps	C1 - C3 - B3 - A1 A3 - A4	Decline to possible extirpation
Bobcat *Lynx rufus*	E	Wooded areas along rivers, especially bluffs	A3 - A10 - C3	Continued decline
River Otter *Lutra canadensis*	T	Vegetated banks of large streams	B2 - C1 - B4 - E	Continued slow decline
Woodland Vole *Microtis pinetorum*	E	Deciduous woodlands; orchards	A3	Continued decline
Cooper's Hawk *Accipiter cooperii*	T	Open woodlands	A3 - B3 - C3	Continued decline
Red-shouldered Hawk *Buteo lineatus*	E	Swamps, river bottoms, other wet woods	A1 - C3 - Competition with red-tailed Hawk	Continued decline, possibly stable at low levels
Marsh Hawk *Circus cyaneus*	E	Marshes, open areas	A2 - A4	Continued decline
Peregrine Falcon *Falco peregrinus*	E	Bluffs and cliffs	A10 - B1	Stable as migrant; possible reintroduction as nesting individuals
Broad-winged Hawk *Buteo platypterus*	T	Extensive deciduous forest	E - Possibly A3 or B	Stable to declining
Long-eared Owl *Asio otus*	T	Hardwoods for nesting and roosting, evergreens for communal winter roosts	E - Possibly D2 - A5	Continued decline
Upland Sandpiper *Bartramia longicauda*	E	Open grassy areas, especially rich pastureland and hay fields	A4	Continued decline

* See Appendix 11 codes for reasons for decline

Appendix 14 Continued.

Common Name/Scientific Name	Status	Habitat	Reasons for Decline*	Projection
Least Tern *Sterna albifrons*	E	River sand bars, beaches	A8 - B6	Continued decline
Blue-winged Warbler *Vermivora pinus*	T	Overgrown areas; brushy old fields	B4 - B3	Possibly stable
Central Newt *Notophthalmus viridescens*	E	Moist woodlands near or surrounding ponds	A1 - A2 - B4	Continued decline
Five-lined Skink *Eumeces fasciatus*	T	Moist forests or piles of debris	A1	Stable at low levels
Western Slender Glass Lizard *Ophisaurus attenuatus*	E	Prairie	A4	Continued decline
Illinois Mud Turtle *Kinosternon flavescens*	E	Sand prairie	A2 - A4 - B2 - C4 D2	Continued decline
Blanding's Turtle *Emydoidea blandingi*	T	Prairie ponds; clean, shallow water	A2 - B2 - B4	Continued decline
Red-eared Turtle *Chrysemys scripta*	T	Lakes, ponds, slow streams, river sloughs	D2 - D1 - B2	Continued decline
Stinkpot *Sternotherus odoratus*	T	Permanent ponds, small lakes, rivers	D2	Stable at low levels
Ornate Box Turtle *Terrapene ornata*	T	Prairies	A4 - C4	Continued decline
Black Rat Snake *Elaphe obsoleta*	T	Wooded areas, bluffs	C3 - A3	Stable, possible decline
Speckled Kingsnake *Lampropeltis getulus*	E	Wooded, hilly terrain	A1 - A3 - A4 - C3	Continued decline
Yellow-bellied Water Snake *Natrix erythrogaster*	T	Quiet waters of ponds, lakes and swamps	A2 - A7 - C3	Continued decline
Graham's Water Snake *Natrix grahami*	T	Sluggish waters such as lakes, river-bottom sloughs & prairie marshes	A2 - A7 - C3	Continued decline

* See Appendix 11 codes for reasons for decline

Appendix 14 Continued.

Common Name/Scientific Name	Status	Habitat	Reasons for Decline*	Projection
Diamondback Water Snake *Natrix rhombifera*	T	Quiet waters of shallow lakes, sloughs and swamps	A2 - A7 - C3	Continued decline
Massasauga *Sistrurus catenatus*	T	Prairie marshes and bluegrass old fields	A2 - C3	Continued decline
Northern Copperhead *Agkistrodon contortrix*	E	Wooded, rocky hillsides	C3 - D2 - A10	Continued decline
Weed Shiner *Notropis texanus*	T	Sand-bottomed creeks with some submerged aquatic vegetation	B6	Continued decline
Bluntnose Darter *Etheostoma chlorosomum*	T	Swamps, floodplain lakes, sloughs, low gradient creeks over mud, clay or detritus	D1	Stable at low levels
Western Sand Darter *Ammocrypta clara*	T	Areas of pure sand in river	B2	Continued decline
Mud Darter *Etheostoma asprigene*	T	Sloughs, lakes, low-gradient large rivers over bottom of organic matter & debris	E	Continued decline probably
Grass Pickerel *Esox americanus vermiculatus*	T	Quiet pools of streams, especially those containing vegetation, marshes, sloughs swamps	B2 - B6	Continued decline
Chestnut Lamprey *Ichthyomyzon castaneus*	T	Medium-sized and large rivers	D1	Stable at very low levels
Pallid Sturgeon *Scaphirhynchus albus*	E	Large turbid rivers over firm, sandy or gravelly bottom	D1 - B5 - B2	Continued sharp decline
Lake Sturgeon *Acipenser fulvescens*	E	Large lakes and rivers	B2 - B5 - C2	Continued decline
Iowa Pleistocene Snail *Discus macclintocki*	E			

*See Appendix 11 codes for reasons for decline

APPENDIX 15

Endangered Species of Missouri Within the GREAT II Study Area

Common Name/Scientific Name	Status	Habitat	Reasons for Decline*	Projection
Indiana Bat *Myotis sodalis*	E	Caves; floodplain woods in summer	A9 - C3 - D4 - B1	Decline; possibly stable at low levels, with protection
Gray Bat *Myotis grisescens*	E	Warm caves	E possibly A9 - B1	Stable at low levels, with protection
River Otter *Lutra canadensis*	E	Vegetated banks of large rivers	B2 - C1 - B4 - E	Continued slow decline
White-tailed Jackrabbit *Lepus townsendii*	E	Sand prairie; open areas	A4 - C1	Continued decline
Cooper's Hawk *Accipiter cooperii*	E	Open woodlands and wood margins	A3 - B3 - C3 - B1 - B4	Continued decline
Marsh Hawk *Circus cyaneus*	E	Marshes, open fields	A2 - A4	Continued decline
Peregrine Falcon *Falco peregrinus*	E	Cliffs or bluffs	A10 - B1	Stable as migrant
Osprey *Pandion haliaetus*	E	Extensive bodies of clear water; elevated nesting sites	B1 - C3 - B2 - A1	Continued decline
Sharp-shinned Hawk *Accipiter striatus*	E	Woodlands, conifers	B3 - A3	Continued decline, stable as migrant
Double-crested Cormorant *Phalacrocorax auritus*	E	Large rivers	A1 - C3 - B1 - B3	Continued sharp decline
Least Tern *Sterna albifrons*	E	River sand bars, beaches	A8 - B6	Continued decline
Barn Owl *Tyto alba*	E	Open country, often near buildings	B1, loss of old buildings	Continued decline
Blanding's Turtle *Emydoidea blandingi*	E	Prairie ponds, river sloughs	A2 - B2 - B4 - C4	Continued decline
Wood Frog *Rana sylvatica*	E	Mesic forests with permanent or semi-permanent ponds	A1 - A2 - A3 - B4	Continued decline

* See Appendix 11 codes for reasons for decline.

Appendix 15 Continued.

Common Name/Scientific Name	Status	Habitat	Reasons for Decline*	Projection
Pallid Sturgeon *Scaphirhynchus albus*	E	Bottom of large, turbid rivers in	D1 - B5 - B2	Continued decline
Lake Sturgeon *Acipenser fulvescens*	E	Large, moderately clear lakes and rivers	B2 - B5 - C2	Continued decline

* See Appendix 11 codes for reasons for decline

APPENDIX 16

Endangered and Threatened Species of Wisconsin in GREAT II Study Area

Common Name/Scientific Name	Status	Habitat	Reasons for Decline*	Projection
Cooper's Hawk *Accipiter cooperii*	T	Open woodlands and wood margins	A3 - C3 - B3	Continued decline
Red-shouldered Hawk *Buteo lineatus*	T	Swamps, river bottoms	A1 - C3 - Competition with red-tailed Hawk	Decline to stable at low levels
Peregrine Falcon *Falco peregrinus*	E	Cliffs or bluffs	A10 - B1	Stable as migrant; possibility of reintroduction of nesting individuals
Bald Eagle *Haliaeetus leucocephalus*	E	Forested areas near large bodies of water	A1 - B3	Stable as migrant
Osprey *Pandion haliaetus*	E	Extensive bodies of clear water; elevated nesting sites	B1 - C3 - B2 - A1	Continued decline
Great Egret *Casmerodius albus*	T	Feeds in ponds, sluggish streams, marshes; roosts in trees; nests in swamp woods or willow thickets	A2	Stable at low levels
Double-crested Cormorant *Phalacrocorax auritus*	E	Large rivers	A1 - C3 - B1 - B3	Continued sharp decline
Forster's Tern *Sterna forsteri*	E	Marshes	A2	Continued sharp decline; low levels as migrant
Pickerel Frog *Rana palustris*	T	Cold springs and rocky fast-running streams	A2	Continued decline; stable in isolated locations
Blanding's Turtle *Emydoidea blandingi*	T	Prairie ponds; clean shallow water	A2 - B2 - B4	Continued decline
Ornate Box Turtle *Terrapene ornata*	E	Prairie	A4 - C4	Continued decline
Massasauga *Sistrurus catenatus*	E	Prairie marshes; bluegrass old field	A2 - C3	Continued decline
Western Ribbon Snake *Thamnophis proximus*	E	Swamp and marsh edges; upland woods	A2	Decline to stable at low levels
Speckled Chub *Hybopsis aestivalis*	T	Fast clear riffles and chutes of large rivers	B2 - B6	Continued decline

* See Appendix 11 codes for reasons for decline.

Appendix 16 Continued.

Common Name/Scientific Name	Status	Habitat	Reasons for Decline*	Projection
Pallid Shiner *Notropis amnis*	T	Clear vegetated pool	B2 - E	Continued decline
Goldeye *Hiodon alosoides*	T	Large and medium sized rivers; tolerant of turbid water, prefers moderate to fast current	E	Stable
Crystal Darter *Ammocrypta asprella*	E	Rather deep and fast-flowing water over sand or gravel	B2 - B6 - D1	Continued decline
Bluntnose Darter *Etheostoma chlorosomum*	E	Sandy, sluggish streams; sloughs, overflow lakes	D1	Stable at low levels
Mud Darter *Etheostoma asprigene*	T	Soft bottoms in sluggish parts of large rivers	E	Stable at low levels
Blue Sucker *Cycleptus elongatus*	T	Rivers over large riffles and deep chutes	B6	Continued decline
Black Buffalo *Ictiobus niger*	T	Large and medium-sized rivers and marginal lakes	E	Stable or possible decline
Higgins' Eye Pearly Mussel *Lampsilis higginsi*	E	Deep water areas of large rivers	B2 - B6	Continued decline
Northern Wild Monkshood *Aconitum noveboracense*	E	Rich woods, shaded ravines, steep talus	C4 - A3	Possible stable in isolated locations
White Lady's Slipper *Cypripedium candidum*	T	Limestone areas, boggy meadows, prairies	A4 - A2	Continued decline
Tubercled Orchia *Habenaria flava* var. *herbiola*	T	Wet woods, swales, shores	A2 - A3	Continued decline
Carex media	E	Moist soil, prairies and meadows	A2 - D1	Continued decline
Pink Milkwort *Polygala incarnata*	E	Dry soil, open ground	A4	Continued decline
Hairy Meadow Parsnip *Thaspium barbinode*	E	Wood edges, thickets	A	Stable in isolated locations

* See Appendix 11 codes for reasons of decline.

APPENDIX 17

Fish and Wildlife/Side Channel Work Groups'
Criteria for Disposal Site Selection

A. General
1. Site in floodplain
2. Runoff will secondarily impact fish & wildlife
3. Site in refuge-potential wilderness area.
4. Site utilized by rare or endangered species
5. Human impact-Rec. use
6. Locally unique habitat
7. Buffer zone
8. Access impacts

B. Fishery Resources
1. Flooded terrestrial areas
   a) spawning
   b) rearing
   c) food production
2. Main Channel
   a) spawning
   b) rearing
   c) dwelling
   d) wintering
   e) food production
3. Main channel borders
   a) spawning
   b) rearing
   c) dwelling
   d) wintering
   e) food production
4. Tailwater
   aa) spawning
   b) rearing
   c) dwelling
   d) wintering
   e) food production
5. Side channels
   a) spawning
   b) rearing
   c) dwelling
   d) wintering
   e) food production
6. River lakes and ponds
   a) spawning
   b) rearing
   c) dwelling
   d) wintering
   e) food production
7. Sloughs
   a) spawning
   b) rearing
   c) dwelling
   d) wintering
   e) food production
8. River tributary
   a) spawning
   b) rearing
   c) dwelling
   d) wintering
   e) food production

C. Benthic Resources
1. Mussel bed
2. Substantial changes in bottom sediments

D. Wildlife Resources
1. Terrestrial communities
   a) wood duck prod. habitat
   b) mast production zones
   c) rookeries
   d) roost sites; eagles-vultures
   e) browse zones; brushy habitat
   f) open areas for diversity
   g) cultivated land
   h) sand prairie
   i) mature timber
   j) unique plant species
   k) unique animal species including amphibians & reptiles
   l) nesting habitat
   m) wintering cover
2. Wetlands
   a) existing or potential emergent zones-shorelands, brood habitat, furbearers
   b) moist soil food prod. area
   c) roosts-wood duck
   d) submerged zones-plants
   e) unique animal species
   f) amphibians & reptiles habitat
3. Open water
   a) areas used by diving ducks-feeding
   b) submerged area-plants
   c) shoreline feeding & cover areas

APPENDIX 18

GREAT II Fish and Wildlife Work Group Dredge Material Site Evaluation Form
Pool #   Date

SITE	FLOODPLAIN			ENDANGERED SPECIES			WILDER-NESS REFUGE		UNIQUE HABITAT	ACCESS IMPACT	SECOND IMPACTS		BENTHIC RESOURCES		FISHERY RESOURCES		WILDLIFE RESOURCES		WILL PROT. MAKE SITE SUITABLE		RECOMMEN-DATIONS			ADDITIONAL COMMENTS
#/R.M.	Yes	No	B.U.	Yes	No	?	Yes	NO	Qualify	Qualify	Ag.	Terr.	Mus.	Sub.	Hab.	Value Obj Sub	Hab.	Value Obj Sub	Yes	No	App.	Not App.	?	

APPENDIX 18A

Instructions For Completion of Dredge Material Site Evaluation Form.

Site: Note site number and river mile.

Floodplain: Place checkmark in proper box.
B.U. - Indicate beneficial use.

Endangered Species: Check appropriate box. If unsure, mark?

Wilderness Area-Refuge: Is the proposed spoil site in a potential wilderness area or a refuge? Check appropriate box.

Unique Habitat: Will spoil impact on a unique habitat, i.e., heron rookery, pecan grove, sand prairie. Note habitat type and value.

Access Impact: Will placement of spoil at site have an impact on fish and wildlife resources. If so, indicate habitat, extent, and species where possible.

Secondary Impacts: Will placement of material at the site result in a secondary impact on aquatic or terrestrial communities. Note habitat per criteria designation in respective column.

Benthic Resources: Will spoils impact on mussel resource or alter substrate.

Fishery Resource: Note habitat type per criteria designation. On the basis of diversity of fish utilizing the habitat, place a value between 1 and 5 in the objective column. Propose we develop matrix similar to GREAT I's. On the basis of your biological experience evaluate the site on the basis of: 1) diversity of habitat, 2) uniqueness of habitat, and 3) relative abundance of habitat. Give the site a value between 1 and 5. This list will be added to as sites are reviewed.

Wildlife Resources: Similar process as noted under Fishery Resources.

Will Protection Make Site Suitable: Self explanatory.

Recommendations: Is site acceptable? Is it unacceptable? Could it be made acceptable?

Additional Comments:

APPENDIX 19

Fish and Wildlife Management/Side Channel Work Groups Criteria

(+) 1. The recommendation is likely to preserve, protect, conserve enhance, or restore the natural and beneficial values of the riverine ecosystem.

"natural and beneficial values" include:
fish and their habitat
wildlife and their habitat
water quality
nutrient cycling
pollutant neutralization
flood storage capacity
groundwater recharge
scientific study and outdoor education
aesthetics and natural beauty

"riverine ecosystem" includes:
floodplains
wetlands
aquatic habitat

(-) 2. The recommendation is likely to destroy, degrade or otherwise reduce in size, value or quality the natural and beneficial values of the riverine ecosystem.

(o) 3. The recommendation is not likely to cause a (significant) change in the quality of quantity of the natural and beneficial values of the riverine ecosystem.

(C) 4. The recommendation needs clarification of purpose or wording change or may only be acceptable under certain conditions.

APPENDIX 20

PFWG Selected Short-Term Disposal Sites With
Impacts on Fish and Wildlife

Pool	Dredge Cut	Disposal Site	Criteria for Rejection[1/]
12	Gordon's Ferry	HD 0	A1, A2, B3a-e, D3a
13	Pomme de Terre	TF 1	A1, B3a-e, D3a
13	Dark Slough	HD 531.4	A1, A2, D2a, B5a-e
13	Sabula Lower	HD 17	A1
		HD 18	A1
13	Savanna Bay Light	HD 4	A1, D2d
		TF 539	A1, A2, B3a-e, D3a
13	Lainsville Lower	HD 20	A1, A2, A5
		TF 540.5	A1, A2, D2a
13	Island 257 Lower	HD 5	A1, A2, A5, D3c
13	Sand Prairie	HD 13	A1, D1f,1
14	Above Lock & Dam 14	HD 2	A1, B2a-e
14	Steamboat Slough	HD 4	A1, B3a-e
		HD 5	A1, A2, D2a
		HD 6	A1, A2, D2a
14	Island 299	TF 505.6	A1, A2, D1a
14	Adams Island Upper	HD 9	A1, D1e,f
		HD 10	A1, D1f

1/ Figures are identified in Appendix 17

Appendix 20 Continued.

Pool	Dredge Cut	Disposal Site	Criteria for Rejection
14	Albany	HD 13	A1, B3a-e
14	Beaver Island	HD 16	A1, D1d
		HD 55	A1, A2
		HD 15	A1, D1a
14	Clinton RR	HD 16	A1, D1d,f
14	Joyce Island	TF 519.5	A1, A2, D1d,f
14	Beaver Slough	HD 11	A1, D1e,f
15	Winnebago Island	HD 3	A1, B2a-e
15	Campbells Island	HD 1	A1, D2a
16	Lock & Dam 15 Approach	HD 6	A1, A2, D1d
16	Below Centennial Bridge	HD 6	A1, A2, D1d
16	Buffalo	HD 4	A1
		HD 5	A1, A2, D1f
16	Montpelier	HD 3	A1, A2, D2a
16	Hershey Chute Upper	HD 1	A1, A2, B3a-e
17	Muscatine Island	HD 8	A1, A2, B5a-e, D2a-f
		HD 9	A1, A2, D2a-d
		HD 10	A1, D1a
17	Blanchard	HD 6	A1, A2
18	Benton Island	HD 3	A1, A2, D11, D2a
18	Huron Island	HD 7	A1, A2, B2a-e, D11, D2a

Appendix 20 Continued.

Pool	Dredge Cut	Disposal Site	Criteria for Rejection
18	Keithsburg Lower	HD 8	A1, A2, B5a-e, D1a, D2a,f
18	Edwards River	HD 11	A1, A2, D2a
18	New Boston Upper	HD 434	A1, A2, D1f, D2a
19	Shokokan	HD 394	A1
		TF 394	A1
19	Kemps Landing	TF 398.1	A1, B3a-e
		TF 398	A1, D1a,f, D2a
19	Craigel Island	HD 3'	A1
19	Burlington Bluff	HD 3'	A1
19	Burlington High-way Bridge	HD 7	A1, A2, D11
19	Rush Island Lower	HD 13	A1, A2
		HD 14	A1, A2
		HD 9	A1, A5, D1f,1
19	Rush Island	HD 13	A1, A2
		HD 14	A1, A2
19	Drew Chute	HD 17'	A1, A5
		HD 15	A1, A5, D2f
		HD 16	A1, A2
20	Lock & Dam 20 Upper Approach	HD 1	A1, B3a-e
		HD 2	A1, B3a-e
20	Meyer Light	TF 345.3	A1
		HD 1	A1, B3a-e

Appendix 20 Continued.

Pool	Dredge Cut	Disposal Site	Criteria for Rejection
20	Fox Island	HD 9	A1, A2, D1g,1
		TF 355	A1, D1g
20	Des Moines River	HD 10	A1, D1d
		HD 10'	A1, D1d
20	Keokuk Steel	HD 10'	A1, D1d
21	Lone Tree	HD 5	A1, A2, D1e,f,1
21	Hogback	HD 5	A1, A2, D1e,f,1
		HD 6	A1, A2, D1f
21	Willow Bar Island	HD 6	A1, A2, D1f
21	Howards	HD 16	A1, A2, B7a-e, D1g
22	Lock & Dam 22 Lower Approach	TF 300.5	A1, A5
22	Turtle Island	HD 2	A1, A2
22	Whitney Island	HD 5	A1, A2, D2a,f
22	Beebe Island	HD 10	A1, D1f
22	Lock & Dam 21 Lower	HD 13	A1, B7a-e

APPENDIX 21

PFWG Selected Long-Term Disposal Sites With
Impacts on Fish and Wildlife

Pool	Dredge Cut	Disposal Site	Criteria for Rejection
13	Savannah Bay Light	TF 539	A1, A2, B3a-e, D3a
		TF 540.5	A1, A2, D2a
13	Island 257	HD 5	A1, A2, A5, D3c
14	Beaver Island	HD 55	A1, A2
		HD 16	A1, D1d,f
14	Clinton R.R.	HD 16	A1, D1d,f
15	Winnebago Island	HD 3	A1, B2a-e
15	Campbell Island	HD 1	A1
16	Buffalo	HD 4	A1
16	Montpelier	HD 3	A1, A2, D2a, D1a
16	Hershey Chute	HD 1	A1, A2, B3a-e
17	Blanchard Island	HD 6	A1, A2
17	Bass Island	HD 4	A1, A2, A5, D1f
18	Benton Island	HD 3	A1, A2, D1e, D2a
		Levee	A1
18	Huron Island	HD 7	A1, A2, B3a-e, D2a, D1e
18	Edwards River	HD 11	A1, A2, D2a
18	New Boston Upper	HD 434	A1, A2, D1f, D2a
19	Shokokon	HD 394	A1
		TF 394	A1

Appendix 21 Continued.

Pool	Dredge Cut	Disposal Site	Criteria for Rejection
19	Kemps Landing	TF 398	A1, D1a,f, D2a
19	Burlington Bluff	HD 3'	A1
19	Rock Island Lower	HD 9	A1, A5, D1f,e
19	Rush Island	HD 9	A1, A5, D1f,e
19	Drew Chute	HD 17'	A1, A5
		HD 15	A1, A5, D2f
		HD 16	A1, A2
20	Lock & Dam 20 Upper Approach	HD 1	A1, B3a-e
		HD 2	A1, B3a-e
20	Meyer Light	HD 1	A1, B3a-e
		TF 345.3	A1
20	Keokuk Steel	HD 10'	A1, D1d
21	Lone Tree	HD 5	A1, A2, D1e,f,l
21	Hogback Island	HD 5	A1, A2, D1e,f,l
		HD 6	A1, A2, D1f
21	Willow Bar Island	HD 6	A1, A2, D1f
21	Howards	HD 16	A1, A2, B7a-e, D1g
22	Lock and Dam 22 Lower Approach	TF 300.5	A1, A5
22	Whitney Island	HD 5	A1, A2, D2a,f

APPENDIX 22

Summary of Methods Used to Determine
Wildlife Consumptive Use

For the purposes of calculating harvest and use values, the study area included the river proper and a strip of land roughly 3-5 miles wide on each side of the river. The proportion of each unit used for reporting data (management zone, county, etc.) which was included in this study area was determined and alloted to respective pools. It was assumed hunting pressure and harvest were uniform throughout the county or zone.

The basic method used in calculating values was the same for all species. The values for zones or counties were multiplied by the percentage found in the study area. Total pool values were determined by adding values for each state in the particular pool.

Information was not available on both harvest and man-days for all species in every pool. Therefore, the estimates given may represent much less than the actual totals. Hunting harvest of fox, coyote, and raccoon were combined with the trapping harvest for these species and are listed under trapping results. The only data available for Wisconsin was that from the Cassville District of the Upper Mississippi River Wild Life and Fish Refuge.

APPENDIX 23

FISH AND WILDLIFE MANAGEMENT WORK GROUP
DREDGED MATERIAL DISPOSAL PLAN HABITAT EVALUATION

I. Introduction

One of the primary goals of the GREAT II study was to develop a Channel Maintenance Plan. This plan was to include a dredged material disposal plan (DMDP) that was both economically and environmentally acceptable.

Although the selection of disposal sites incorporated environmental considerations, there was a lack of quantitative analysis based on relative habitat value. Thus, it was necessary for the FWMWG to devise a means to compare the impacts of the various planning alternatives of the DMDP and to develop appropriate mitigation measures. The impacts of the other aspects of the Channel Maintenance Plan were not evaluated.

The evaluation was done by modifying the U.S. Fish and Wildlife Habitat Evaluation Procedures. The following discussion evaluates the impact of the DMDP on birds and mammals of the study area. It provides a relative comparison only. Since the ultimate disposition of the dredged material into aquatic habitats is unknown, no aquatic habitat evaluation could be done. Future research on tracking of dredged material in the river will aid in an aquatic habitat analysis.

This assessment compares each of the planning alternatives considered by the GREAT II Team. Four alternatives were developed by the Plan Formulation Work Group (PFWG) and were submitted to the Team for consideration. In response, the Team reviewed all disposal sites considered by the PFWG (over 750 sites) and selected two other disposal plan alternatives. These are the "Primary Sites Without Stockpiling" and Primary Sites With Stockpiling." The planning alternatives used in this analysis are as follows:

1. Historical - contains historical disposal sites or sites similar to historical type sites.
2. Floodplain - all disposal sites in floodplain.
3. Removed from floodplain - all disposal sites are out of the floodplain except beach nourishment sites and stockpiling sites.
4. PFWG Long-Term - long term plan approved by PFWG.
5. Primary sites without stockpiling - selected sites of GREAT II Team.
6. Primary sites with stockpiling - selected sites of GREAT II Team with productive use of material.

II. Methods

The data used in this habitat evaluation summarizes the terrestrial habitat potentially impacted for each of the planning alternatives. The planning alternatives and data used in the analysis are summarized in Table 1.

The first step was to determine the type of habitats impacted by the disposal alternatives. The habitat types were categorized into the following:

1. Wetlands - all types except forested wetlands
2. Lowland hardwoods - all forested wetlands
3. Argricultural field - all areas being actively farmed including plowed fields
4. Levee - levees and areas adjacent to levees usually consisting of grasses, forbs, vines, shrubs, and a few trees
5. Old field - includes fields not in cultivation, pastures, and all other areas that are a mix of grasses, forbs, shrubs, and trees that do not fit into one of the other habitat types
6. Aquatic - all open water habitats except wetlands
7. Mowed grass - grass mowed regularly (i.e. more than once a year)
8. Breeched levee - levee in U.S. FWS Spring Lake Wildlife Management Area. Evaluates restoration of levee only and not secondary impacts of improved wildlife management.
9. Dredged material - includes all non-vegetated sandy areas
10. Developed - includes all areas which are highly disturbed by man's activities

Each disposal alternative was grouped into one of the above habitat types based on U.S. FWS 1975 aerial photography and photos taken by the Dredged Material Uses Work Group (DMUWG) for the Dredged Disposal Site Selection Task Force.

The assessment of the alternatives was done using, with certain modifications, the habitat evaluation procedures defined in a manual distributed by the U.S. Fish and Wildlife Service (Division of Ecological Services, 1976). Basically, the evaluation assigns a habitat unit (HU) value to each of the habitat types in the study area. The HU value is determined by rating (between 0 and 10) the evaluation species. The habitat unit is defined as an estimate of annual production of the habitat. The evaluation then compares losses and gains in HUs for each alternative being considered for the 50-year life of the project. The final product of the evaluation is a comparison of the average annual HUs of each of the planning alternatives.

The evaluation species used in the habitat evaluation were chosen by FWMWG. Determining factors in making this selection were habitat utilization of the river corridor, unique or sensitive species,

TABLE 1

GREAT II DISPOSAL PLAN ALTERNATIVES
HABITAT IMPACT ANALYSIS[1]

Habitat	Historical Acres	Historical HU Loss/Gain	Floodplain Acres	Floodplain HU Loss/Gain	RFFP Acres	RFFP HU Loss/Gain	PFWG Long-Term Acres	PFWG Long-Term HU Loss/Gain	Primary Sites Acres	Primary Sites HU Loss/Gain	Primary Sites W/ Stockpiling Acres[2]	Primary Sites W/ Stockpiling HU Loss/Gain
Wetlands	8	-284	0	0	0	0	5	-154	0	0	0	0
Lowland Hardwoods[3]	233	-2072	297	-2643	195	-1734	288	-2567	415	-3611 (-3437)	166	-1677 (-1529)
Agriculture Field	0	0	166	-2127	304	-3893	124	-1589	64	-819 (-948)	16	-222 (-119)
Levee	NE[4]	-	NE	-	NE	-	NE	-	82	-558 (-606)	18	-701 (-569)
Old Field	20	-164	15	-121	12	-95	11	-87	74	-607 (-605)	33	-284 (-271)
Open Water[5]	(1414)	-	(166)	-	(188)	-	(266)	-	-	-	-	-
Mowed Grass	NE	-	NE	-	NE	-	NE	-	10	-20 (-20)	2	-4 (-4)
Levee Plug	NE	-	NE	-	NE	-	NE	-	18	+70 (+130)	18	+70 (+130)
Dredged Material	267	-374	39	-54	0	0	118	-165	157	-220 (-158)	101	-182 (-275)
Developed	18	-48	229	-596	173	-150	151	-393	200	-520 (-557)	58	-93 (-112)
Total	546	-2942	746	-5541	684	-6172	697	-4955	1020	-6285 (-6202)	412	-3089 (-2752)

1 - Average annual habitat losses or gains over 50 years. Based on a one-in-ten year frequency of disposal.
2 - Acres reduced for beneficial uses. Assumes capacity for 2 disposal volumes.
3 - Disposal in lowland hardwoods and dredged material is to 6 feet. All others are to 12 feet.
4 - NE - Not evaluated.
5 - Acreage in parenthesis taken from PFWG. Assumptions to determine this acreage were not accepted by GREAT II Team, so impacts were not evaluated.

HU Loss/Gain Difference between existing habitat units and projected average annual habitat units over 50 years.

and available data for evaluation. Potential evaluation species were then categorized into an ecological community according to their feeding and reproductive guilds (association of species by feeding and reproducing location and trophic level). This resulted in selection of fifteen species for evaluation.

The species were chosen to evaluate terrestrial impacts only. The effects of disposal in aquatic habitats are largely unmeasured and the utilization of dredge material by aquatic species is also unknown. As a result no aquatic analysis was attempted. This introduces a bias in the study that will be discussed in more detail later.

Following the selection of evaluation species, the criteria used in the evaluation were determined. The species used as evaluation elements and criteria are listed in Table 2. The criteria are based on literature review of the life requirements of the selected species. Besides the listed criteria, the evaluator's knowledge of the species and the sample site was also incorporated into the ranking procedure.

The Evaluation Team was composed of three wildlife biologists representing the following agencies: (1) Iowa Conservation Commission, (2) U.S. Army Corps of Engineers, and (3) U.S. Fish and Wildlife Service. The team conducted a field inspection of representative sites. Some sites were not inspected and were evaluated by description only and aerial photos since the team members had previously visited the sites. Each evaluation species was assigned a rank between zero and ten, in accordance with the capability of the habitat to provide life needs for the species being considered. A value of ten HUs indicated that all habitat needs are present in desirable proportions for that species. Lower values indicate some deficiency in the requirements. A value of zero HU indicates a complete lack of use by the species. Complete agreement of all the Evaluation Team members was required before assigning a ranking. A value was computed for each habitat based on the total HUs assigned. Theoretically, a value of 100 would be the ideal habitat for all species evaluated. However, this is impossible since not any habitat provides all the life requirements for all 15 species being evaluated. The existing habitat unit values determined by the evaluation team are:

1.	Wetlands	44.7
2.	Lowland hardwoods	31.3
3.	Agricultural field	26.0
4.	Levee	24.0
5.	Old field	16.0
6.	Aquatic	11.3
7.	Mowed grass	10.0
8.	Breeched levee	10.0
9.	Dredged material	6.6
10.	Developed	4.9

TABLE 2 CRITERIA FOR EVALUATION SPECIES

Gray Squirrel	Muskrat	Raccoon
8-10 dense hardwood forest availability of bushy understory along river-bluff or in river bottom availability of a variety of trees including hickory, pecan, oak, walnut, elm, and mulberry cornfield nearby availability of water	8-10 stable water level of less than 4' deep short distance (less than 100 yards) to emergent aquatic vegetation and other building materials banks suitable for den construction and covered with vegetation corn nearby availability of cattail, lotus, bulrush for food	8-10 abundance of large dead trees in hardwood timber close proximity to water availability of invertebrates close proximity to cornfield
4-7 moderate of the above trees stands with little diversity	4-7 moderate of the above semi-fluctuating water level, burrows and lodges occassionally flooded or inundated	4-7 moderate of above
1-3 little of the above	1-3 little of the above severely fluctuating water levels, changing daily or recurrent short-term basis no vegetation available	1-3 little of the above
White-tailed Deer	**River Otter**	**Striped Skunk**
8-10 timbered area, abundance of edge and clearings (40-70% canopy closure) little disturbance by man, e.g. no roads and buildings actively used abundance of variety of herbaceous vegetation present at least 3 browze species available water availability (within 1 square mile) no grazing of area by livestock abundance of understory growth	8-10 stream, river or lake bordered by timber fallen trees present understory vegetation present rocky ledges present water with low turbidity old burrows of muskrats, beaver or woodchuck present	8-10 edge of timber, grass border fence rows present open grassy field borken by wooded ravines creek, drainage ditch or other source of water nearby abundant numbers grasshoppers, beetles, crickets and rodents
4-7 moderate of above no escape cover within 100 yards	4-7 moderate of the above water turbid little timber and understory vegetation	4-7 moderate of the above
1-3 little cover, no edge habitat no escape cover available within 200 yards excessivb disturbance of area by man heavy grazing of timber by cattle	1-3 little of the above	1-3 little of the above water not nearby

Table 2 continued.

Red-headed Woodpecker	Bald Eagle	Wood Duck	Great Blue Heron
8-10 forest edge with much open habitat (30-60% tree canopy enclosure) numerous dead trees, devoid of bark, available for excavation with dbh greater than 12" availability of acorns, beechnuts, flying insects and corn at least 3 mast producing tree species present	8-10 Presence of tall tree species (sycamore and maple) availability of water that remains open year-round area remote from human influences, at least ½ mile from actively used paved road site sheltered from prevailing winds	8-10 mast producing trees present with many canopy openings cavity producing trees present e.g. bald cypress, sycamore, silver maple, black ash, sour gum, black willow irregular stream bank probability of high water in March and April overhanging wooded vegetation present emergent herbaceous vegetation present oak species available for acorn source water within ¼ mile	8-10 availability of shallow water within 2 miles availability of fish, snakes, frogs, lizards, insects & small mammals presence of cover vegetation along shallow waters tall trees (mature or old-growth stands) area remote from human influences, at least ½ mile from an actively used paved road site sheltered from prevailing winds
4-7 moderate of the above fewer dead trees	4-7 moderate of the above	4-7 moderate of above close proximity of grain fields; corn, milo, wheat water within ½ to 1 mile dense woodland	4-7 moderate of the above some degree of isolation from humans
1-3 little of the above	1-3 little of the above	1-3 water not close-by, greater than 1 mile away little of the above	1-3 little of the above area easily accessible by humans site open to prevailing winds
White-breasted Nuthatch	**Pheasant**	**Semi-palmated Sandpiper**	**Green Heron**
8-10 presence of acorn-producing tree species, mixed deciduous woods availability of mature cavities or old woodpecker holes in tall trees	8-10 availability of grain fields, especially corn and soybeans suitability of soil type, i.e. calcium and grit present short grasses and shrubs available for cover	8-10 availability of shallow water areas (less than 3" deep) within 300 yards availability of sparsely vegetated area with mixed grasses and forbs about 2 feet in height presence of aquatic invertebrates	8-10 availability of shallow water availability of small sunfish, minnows and crayfish presence of cover vegetation along shallow waters presence of small trees an- shrubs e.g. willows, crab apple, hawthorn, buttonbush, and cottonwood
4-7 moderate of the above	4-7 moderate of the above	4-7 moderate of the above	4-7 moderate of the above
1-3 little of the above	1-3 little of the above	1-3 little of the above	1-3 little of the above

The existing habitat unit value of each of the habitat types provides a relative ranking of habitats in the study area. However, this is biased by the lack of aquatic species included in the analysis. As a result the existing value of wetlands, aquatic, and breeched levee habitats are lower than would be expected. Agricultural habitat in the study area has a relatively high habitat value because small fields and marginal crop producing fields were chosen for disposal sites. These sites have good diversity due to associated fence rows, adjacent woodlots, and brushy areas. In addition, old field habitat has a relatively low value due to the inclusion of a number of sites that have reestablished vegetation after severe human disturbances (ie. abandoned sand quarries).

In order to evaluate the alternatives over time, certain assumptions had to be made at each disposal site concerning the periodicity of disposal and the impacts of subsequent disposals on the habitat. Ideally, a habitat evaluation should be conducted for baseline conditions and for points in time when the habitat unit values are expected to change, i.e. before and after each disposal. For instance, many sites have disposal frequencies of once every five years. This would require an impact assessment for years 0, 5, 6, 10, 11...etc. Using a project life of 50 years would require 21 projected assessments. This was beyond the time constraints of this study. To reduce analysis time, assessments were made for baseline conditions, the year immediately after the first disposal, the year immediately preceding the second disposal and at 50 years. From these data, the other target assessments were determined by interpolation.

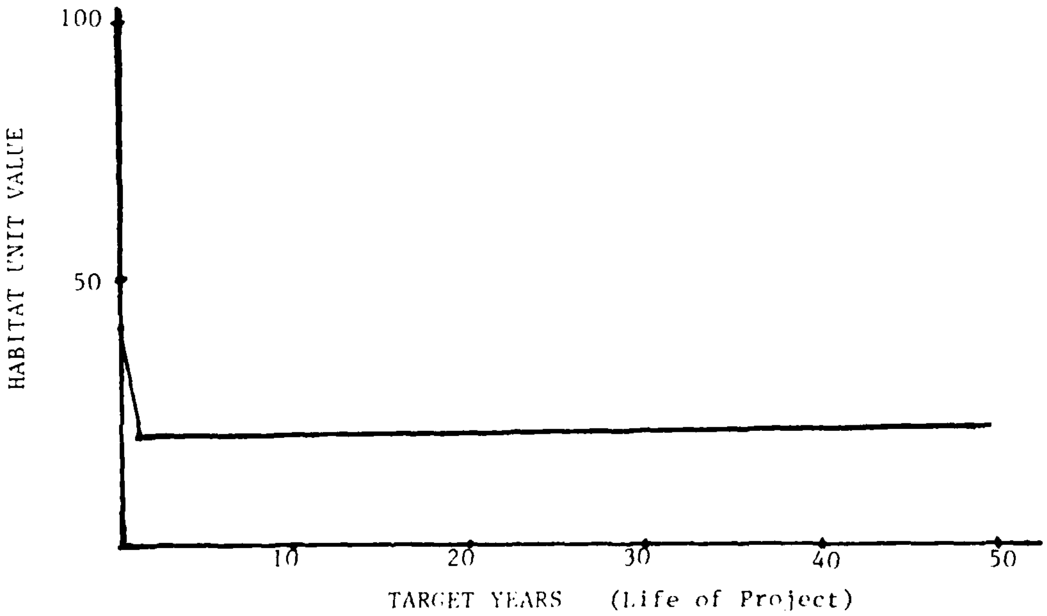
Comparison of the different planning alternatives was accomplished by computing average HU value for all disposal sites in each of the target years evaluated. When a site is impacted, changes occur in its ability to provide the life needs of a species. As a result there is a loss or gain in habitat units at the site. A loss of habitat units indicates a reduction in the ability of the site to provide for one or more of the evaluation species.

After the habitat unit values were determined for all species, these points were used to construct a graph of target year versus habitat value (see Figure 1). For comparison purposes, a one-in-ten year frequency of disposal was used for each of the planning alternatives (Table 1). The actual frequencies of disposal were also used for the Primary Site alternatives to more accurately reflect habitat losses. It was assumed that for the stockpile alternative the HU value would not increase above the first target year since it would be continually disturbed (Figure 2) due to removal of material for beneficial use. Finally, using the area under the curve, an average annual HU value was computed to compare to the existing HU values. This yields the losses or gains in habitat unit value per acre.

The next step was to determine the acres impacted. The area of disposal impact was determined by assuming the 50-year volume of

Figure 1. Changes in HUV over life of project for a hypothetical non-stockpile site.

Figure 2. Changes in HUV over project life for a hypothetical stockpile site.



material would be distributed over the site at a disposal height of 12 feet except for sites located in lowland hardwoods and dredged material beaches which have a disposal height of 6 feet. Although the PFWG determined an amount of open water habitat impacted, the GREAT II Team could not agree with these assumptions. Therefore, no acreage was assigned for the Primary Sites to aquatic (open water) disposal or to material that will eventually slough off from disposal in the floodplain, especially beach disposal. The stockpile alternative assumed that the disposal site would hold the volume of material from two dredging occurrences. Only sites indicated as potential beneficial use sites by the DMUWG were considered as stockpile sites. See Table 3 for summary of acres impacted.

Primary site alternatives evaluated a single disposal site for each of the known cuts. No "beach nourishment only" or open water disposal (2 sites only) sites were included in the evaluation. For more information on the other planning alternatives, see the PFWG Technical Appendix.

III. Results

Table 1 lists the results of habitat assessment for the PFWG-CMP and GREAT II Team Primary Site alternatives. It is based on the habitats potentially impacted by disposal on an average annual basis. The PFWG Short Term Selected alternative has not been evaluated since it was only a 5 year plan.

Table 4 shows the existing HU values and the losses or gains in HU value by habitat type and pool for the Primary Site alternative "without stockpiling." Table 5 shows the same information for the Primary Site alternative "with stockpiling" implemented.

IV. Discussion of DMDP Alternatives

An assessment of Table 1 shows:

1. The Historical plan has a low terrestrial loss. However, this analysis does not include an evaluation of aquatic habitat losses which would probably more than double the losses due to the impacts on waterfowl, benthos and other aquatic resources from open water disposal and sloughing of material from beach and floodplain disposal.

2. The Floodplain plan has high losses of lowland hardwood and agricultural habitats.

3. The Removed from Floodplain plan has the greatest loss of agricultural habitat. A lesser amount of lowland hardwoods is impacted than with the other alternatives.

4. The Long Term Selected plan has losses similar to the Floodplain alternative. However, this does not include losses due to open water disposal and sloughing from beach erosion.

TABLE 3

EXISTING HU AND HU LOSS/GAIN OF PRIMARY SITES (WITHOUT STOCKPILING)

Pool	Wetlands		Lowland Hardwoods		Agricultural Field		Levee		Old Field		Open Water		Mowed Grass		Breeched Levee		Dredged Material		Developed		Total	
	E	Δ HU	E	Δ HU	E	Δ HU	E	Δ HU	E	Δ HU	E	Δ HU	E	Δ HU	E	Δ HU	E	Δ HU	E	Δ HU	E	Δ HU
11	0	0	0	0	325	-163	0	0	0	0			0	0	0	0	165	-25	166	-88	656	-276
12	0	0	0	0	0	0	0	0	0	0			0	0	0	0	0	0	31	-17	31	-17
13	0	0	391	-111	0	0	751	-213	0	0			100	-20	175	+130	0	0	61	-33	1478	247
14	0	0	1725	-454	0	0	0	0	390	-200			0	0	0	0	0	0	137	-73	2252	-727
15	0	0	0	0	0	0	0	0	0	0			0	0	0	0	53	-11	0	0	53	-11
16	0	0	793	-201	0	0	0	0	225	-116	NO DATA AVAILABLE	NO DATA AVAILABLE	0	0	0	0	0	0	110	-59	1128	-376
17	0	0	563	-167	0	0	0	0	0	0			0	0	0	0	0	0	196	-104	759	-271
18	0	0	516	-130	645	-322	360	-133	200	-103			0	0	0	0	84	-16	0	0	1805	-704
19	0	0	2229	-596	0	0	0	0	341	-177			0	0	0	0	42	-25	50	-27	2662	-825
20	0	0	2998	-766	697	-463	0	0	0	0			0	0	0	0	396	-60	40	-22	4131	-1311
21	0	0	1643	-471	0	0	0	0	21	-10			0	0	0	0	99	-21	107	-68	1870	-570
22	0	0	2113	-541	0	0	864	-260	0	0			0	0	0	0	0	0	81	-69	3058	-870
Total	0	0	12971	-3437	1667	-948	1975	-606	1177	-606			100	-20	175	+130	839	-158	979	-560	19883	-6205

E - existing habitat units

Δ HU - loss or gain in habitat units

TABLE 4

EXISTING HU AND HU LOSS/GAIN OF PRIMARY SITES (WITH STOCKPILING)

Pool	Wetlands		Lowland Hardwoods		Agricultural Field		Levee		Old Field		Open Water		Mowed Grass		Breeched Levee		Dredged Material		Developed		Total	
	E	Δ HU	E	Δ HU	E	Δ HU	E	Δ HU	E	Δ HU	E	Δ HU	E	Δ HU	E	Δ HU	E	Δ HU	E	Δ HU	E	Δ HU
11	0	0	0	0	65	-55	0	0	0	0	No Data Available		0	0	0	0	165	-25	86	-41	316	-101
12	0	0	0	0	0	0	0	0	0	0			0	0	0	0	0	0	12	-4	12	-4
13	0	0	78	-25	0	0	216	-151	0	0			20	-4	175	+130	0	0	12	-4	501	-54
14	0	0	901	-247	0	0	0	0	312	-155			0	0	0	0	0	0	37	-12	1250	-414
15	0	0	0	0	0	0	0	0	0	0			0	0	0	0	53	-11	0	0	53	-11
16	0	0	793	-201	0	0	0	0	61	-33			0	0	0	0	0	0	20	-6	874	-240
17	0	0	563	-167	0	0	0	0	0	0			0	0	0	0	0	0	25	-8	588	-175
18	0	0	31	-10	78	-42	72	-44	32	-17			0	0	0	0	82	-186	0	0	495	-299
19	0	0	329	-106	0	0	0	0	112	-60			0	0	0	0	42	-25	22	-12	505	[illegible]
20	0	0	328	-104	273	-42	0	0	0	0			0	0	0	0	26	-7	20	-6	647	[illegible]
21	0	0	1258	-369	0	0	0	0	16	-9			0	0	0	0	99	-21	25	-10	1398	-109
22	0	0	892	-300	0	0	864	-394	0	0			0	0	0	0	0	0	27	-9	1733	[illegible]
Total	0	0	5173	-1529	416	-119	1152	-589	533	-274			20	-4	175	+130	667	-275	286	-112	8122	[illegible]

E - existing habitat units

Δ HU - loss or gain in habitat units

TABLE 5

ESTIMATED ACRES REQUIRED FOR DISPOSAL AT PRIMARY SITES

Pool	Wetlands		Lowland Hardwoods		Agricultural Field		Levee		Old Field		Open Water		Mowed Grass		Breeched Levee		Dredged Material		Developed		Total[3]	
	W/O[1]	With[2]	W/O	With	W/O	With	W/O	With	W/O	With	W/O	With	W/O	With	W/O	With	W/O	With	W/O	With	W/O	With
11	0	0	0	0	12.5	2.5	0	0	0	0			0	0	0	0	25	25	33.8	17.5	71	45
12	0	0	0	0	0	0	0	0	0	0			0	0	0	0	0	0	6.3	2.5	6	3
13	0	0	12.5	2.5	0	0	31.3	9.0	0	0			10	2	17.5	17.5	0	0	12.5	2.5	84	34
14	0	0	55.1	28.8	0	0	0	0	24.4	19.5			0	0	0	0	0	0	27.9	7.5	107	56
15	0	0	0	0	0	0	0	0	0	0			0	0	0	0	8	8	0	0	8	8
16	0	0	25.5	25.5	0	0	0	0	14.1	3.8			0	0	0	0	0	0	22.5	4.0	62	33
17	0	0	18	18	0	0	0	0	0	0	NO DATA AVAILABLE		0	0	0	0	0	0	40	5.0	58	23
18	0	0	16.5	1.0	24.8	3.0	15.0	3.0	12.5	2.0			0	0	0	0	42.8	42.8	0	0	112	52
19	0	0	71.2	10.5	0	0	0	0	21.3	7.0			0	0	0	0	6.3	6.3	10.3	4.5	103	28
20	0	0	95.8	10.5	26.8	10.5	0	0	0	0			0	0	0	0	60	4.0	8.2	4.0	191	29
21	0	0	52.5	40.2	0	0	0	0	1.3	1.0			0	0	0	0	15	15	21.9	5.0	91	62
22	0	0	67.5	28.5	0	0	36.0	36.0	0	0			0	0	0	0	0	0	16.6	5.5	120	70
Total	0	0	415	166	61	16	82	48	74	33			10	2	18	18	157	101	200	58	1020	112

1/ Primary Sites "without stockpiling" - All sites contain 50 year volume of material. Lowland hardwoods and dredged material disposal depth is 6 feet. For all other habitat types, disposal depth is 12 feet.
2/ Primary Sites "with stockpiling" - all stockpile sites contain volume of two dredging occurrences to a depth of 12 feet. For all sites that productive use has not been identified, acreage is same as "without stockpiling".
3/ Totals have been rounded.

5. The Primary Site alternative "without stockpiling" has the greatest percent loss in lowland hardwoods. It should be noted that this plan does not inlcude losses in open water habitat due to beach slough. It also does not include a reduction in site size due to beneficial use.

6. By including beneficial use in the disposal plan, all impacts are significantly reduced as can be seen for tne Primary Site alternative "with stockpiling." However, lowland hardwoods still have the greatest impacts.

A deficiency in this evaluation that could not be avoided is that the effects of disposal on aquatic species were not considered. Effects on aquatic species would be especially important when considering the impacts of disposal methods that would allow material to return to the river, such as open water disposal (thalweg disposal or island creation) or beach disposal. Effects of this type of disposal on the biota have not been quantified. The choice of evaluation species reflects this lack of knowledge. The recommendation by the GREAT II Team to trace dredged material by means of flourescent dye should aid in filling this void.

Based on all available information, the GREAT II Team chose sites which were most environmentally and economically acceptable. These have been grouped into the Primary Site alternative. This alternative has been further sub-divided into an alternative "without stockpiling" and one "with stockpiling" for beneficial use. Tables 4 and 5 show the habitat evaluation of these alternatives based on an actual frequency of disposal analysis. An evaluation of this information shows:

1. "Without stockpiling" the greatest percent loss in existing habitat value occurs in agricultural field, old field, and developed habitats.

2. "With stockpiling" the greatest percent loss in existing habitat value occurs in levee and old field habitats.

3. The breeched levee habitat gains habitat units due to the creation of terrestrial habitat from aquatic habitat. This does not consider aquatic habitat losses or the secondary gain in habitat value from improved wildlife management.

4. The greatest loss in HUs is in lowland hardwood habitat for both the "with stockpiling" and "without stockpiling" alternatives.

5. The greatest loss in HUs is in Pool 20 for both alternatives.

6. There is approximately a 32 percent loss in habitat value "with" or "without stockpiling".

7. "With stockpiling" there is a 56 percent reduction in the amount of HUs lost "without stockpiling."

8. Stockpiling for beneficial use substantially (greater than 50 percent) reduces the HU losses in pools 11, 12, 13, 18, 19, and 20 (Table 6).

TABLE 6

PERCENT REDUCTION IN HU LOSS BY STOCKPILING[1]

Pool	HU Loss Without Stockpiling	HU Loss With Stockpiling	Percent Reduction
11	- 276	- 101	63%
12	- 17	- 4	76%
13	- 247	- 34	86%
14	- 727	- 414	43%
15	- 11	- 11	0%
16	- 376	- 240	36%
17	- 271	- 175	35%
18	- 704	- 299	58%
19	- 825	- 203	75%
20	-1311	- 159	88%
21	- 570	- 409	28%
22	- 870	- 703	19%
Total	-6205	-2752	56%

[1] Based on HU losses at Primary Sites without stockpiling.

V. Mitigation of Disposal Impacts

The final step in the habitat evaluation is to determine the mitigation requirements of the selected DMDP. Mitigation as defined by the President's Council on Environmental Quality and supported

by the U.S. FWS is that planning process which 1) avoids impacts altogether by not taking a certain action or parts of an action, 2) minimizing impacts by limiting the degree or magnitude of the action and its implementation, 3) rectifying the impact by repairing, rehabilitating, or restoring the affected environment, and 4) reducing or eliminating the impacts over time by replacing or providing substitute resources or environments (40 CFR 1508.20 a-e).

Historically, dredge material has been deposited in areas closest to the dredge site and allowed to revegetate by natural succession. The height and depth of the deposit has influenced the degree of loss of the existing vegetation as well as subsequent vegetation capable of pioneering the site.

It is generally accepted that most dredge disposal causes habitat losses to varying degrees, as shown above. For wildlife habitat, this is inherent in the fact that dredged material has the second lowest habitat value per acre (the lowest is developed areas) of all the wildlife habitats evaluated by the FWMWG. As stated before, the impacts on aquatic species habitat are unquantified.

Excessive disposal at any site can void the area of vegetation and lower its wildlife value. Lesser deposits destroy understory and are subject to erosion. However in some cases, limited disposal at a site can lessen habitat losses by creating nesting cavities from the few trees that are killed by the disposal. This was taken into consideration in the habitat evaluation. Secondary impacts also occur such as beach disposal that induces recreation into a site. This increased activity results in disturbance of habitat. For this study, secondary impacts have not been evaluated. However, they will be considered in development of the mitigation plan.

The objectives of dredged material disposal mitigation include: 1) minimizing habitat losses through the site selection process, 2) compensation for wildlife habitat losses through habitat improvement subsequent to the disposal, 3) minimizing recreational use of federal refuges through site landscape, design, and vegetation, 4) erosion control, and 5) compensation for losses at a site other than the disposal site.

The first objective was addressed by the GREAT II Team under their Site Selection Priorities. These have been developed primarily from the habitat evaluation. (Note again that aquatic habitat is unmeasured. Its position in the list is based on judgement.) In priority order, they are:

1. Material at site has a beneficial use which will cause it to be completely removed from the riverine environment and which will have little or no adverse environmental impact.

2. Site has beneficial use potential that will have little or no adverse environment impact.

3. Site is an OSIT approved beach.

4. Lowland hardwood sites previously used for disposal.

5. Agricultural land sites other than prime.

6. Pioneer vegetation (mix of herbaceous and woody vegetation usually found adjacent to levees in the study area).

7. Lowland hardwood sites not previously used for disposal.

8. Shoreline sites not previously used for disposal.

9. Open water sites.

10. Prime agricultural lands.

11. Wetlands.

Based on these priorities, a disposal plan was developed. This is the Primary Site alternative "with stockpiling." Although this alternative has greatly reduced the habitat losses, there is still a loss of 2752 terrestrial HUs which require mitigation. Several measures can be accomplished to further reduce or compensate for this loss. The extent of aquatic degradation is unknown, so no mitigation of aquatic habitat impacts could be determined using this method.

Inspection of the mitigation objectives and the Primary Site alternative "with stockpiling" reveal several measures which should be pursued. First, as can be seen in Table 5, impacts can be reduced by increasing the beneficial use of dredged material. This can be done by (1) increasing demand at potential sites such that all material is removed from the site before the next disposal occurence and/or (2) by increasing the number of stockpile sites. Both will be accomplished by the GREAT II Team recommendation for a long-term commitment to beneficial use. In addition, for the former, OSIT will evaluate this priority each time a disposal site selection is made. The latter will require specific promotion of increased beneficial use in all pools, especially Pools 14, 15, 16, 17, 21 and 22.

The second mitigation objective involves primarily revegetation of disposal sites not used for stockpiling. This involves compensation of approximately 1700 HU. Inspection of these losses reveals that the majority occurs in lowland hardwood habitat and within all guilds of species utilizing this habitat type. Therefore, revegetation of the sites should be accomplished.

Vegetation will not only increase habitat value but also could preclude recreational use and protect the site from severe erosion, the third and fourth objectives. However, dredged material is typically pure sand with little or no organic matter content. Without organic matter, the top horizon layer does not retain moisture and lacks essential plant nutrients. Past attempts to revegetate disposal

sites in an economically feasible way with different species of grasses have been basically unsuccessful (Dredged Material Uses Work Group Appendix, GREAT I, 1980).

To achieve adequate mitigation it becomes apparent that organic matter must be introduced to the dredged sand. At present, no practical way of revegetating sand piles is available, but the Rock Island District will experiment with silt, straw and wood chip treatments. It has been suggested that compost, whey, sewage sludge, or other organic solid waste material also be experimented with. However, at this time, placement of solid waste in the floodplain is strictly prohibited.

Organic matter can be applied using a silt overburden. This method is being experimentally used on the Fulton Flood Protection Project-Stage III-C, Cattail Slough, Illinois. Basically, silt is spoiled over the sand layer using standard dredging techniques. The containment of the water in the silt material by perimeter dikes is essential to reduce erosion and to control turbidity.

Straw and wood chip mulches are suitable if their carbon to nitrogen ratio is less than 25:1. Above this C to N rate, these materials could inhibit nitrogen, phosphorous, and sulfur availability[1]. Hay and grass mulches may also present problems with nutrient balance.

Hand application of these mulches is suitable only for small areas. Mechanical methods include hydroseeding and hydromulching. This process provides seed, fertilizer, and mulch dispersed in a water solution spray and is appropriate for large areas (additional information is available from Kay[2]).

Once organic material is introduced, revegetation should not be up to natural succession. Creation of monotypic environments of willow and maple offer minimum diversity, and will not recoup HU losses as periodic disposal continues. Beneficial terrestrial species that could be introduced include a variety of oak, walnut, ash, elm, redstem dogwood, and Japanese honeysuckle species. It is the opinion of the FWMWG that successful revegetation of lowland hardwoods with these species or others beneficial to wildlife will adequately mitigate the HU losses.

This leaves approximately 1000 HUs requiring mitigation at stockpile sites. Since these sites are subject to recurrent disturbance, it is not practicable to mitigate losses at the disposal site. Therefore, the last mitigation objectives must be employed. Measures to meet this objective include refuge levee repair, backwater renovation or wetland creation. Providing sand for levee repair of refuge and game management areas should be adopted whenever

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[1]USDA. 1979. Mining and Reclamation in the West. Gen. Tec. Rept. 64, Intermountain For. and Range Exp. Stat., Ogden, UT.

[2]Kay, B.L. 1976. Hydroseeding, straw, and chemicals for erosion control. Agron. Prog. Rept. No. 77. Univ. Cal, Davis. 14pp.

possible. This will provide for secondary habitat improvement through wildlife management. Another technique for habitat improvement involves backwater restoration. HU values can potentially be increased through dredging for both aquatic habitat (backwater renovation) and terrestrial habitat (deposition and revegetation of silt material). The SCWG has identified specific backwater areas that are in need of alteration (SCWG 3504 and FWMWG 3035).

Creation of wetlands from dredged material was not considered in detail by GREAT II. However, Section 150 of Public Law 94-587 authorizes the COE to plan and establish wetland areas in connection with dredging for a water resources development project and should be evaluated by the future Fish and Wildlife Interagency Committee (FWIC) for possible implementation.

The exact improvement of habitat value from the above measures will be site specific and will have to be monitored by the FWIC.

VI. Recommendations

Based on the above discussion, the FWMWG recommends:

1. Each Primary Site be evaluated by the FWIC to determine the appropriate mitigation measures for that site. This should be developed into a total mitigation plan.

2. Mitigation measures be monitored by the FWIC to determine changes in HU values. The mitigation plan should be re-evaluated as appropriate.

3. To properly address aquatic habitat impacts, additional information be collected particularly in association with tracing "tagged" dredged material. Material would have to be tagged for all types of disposal (i.e. beach, thalweg, double pumping, etc.).

4. The habitat evaluation and mitigation plan be updated for new disposal sites and, as information becomes available, on the impacts on aquatic habitats.

APPENDIX 24

Acronym List For FWMWG Appendix

CMP - Channel Maintenance Plan

COE - Corps of Engineers

DMUWG - Dredge Material Uses Work Group

DO - Dissolved Oxygen (p. 15)

DRWG - Dredging Requirements Work Group

FPMWG - Floodplain Management Work Group

FRA - Federal Railroad Administration

FWIC - Fish and Wildlife Interagency Committee

FWMWG - Fish and Wildlife Management Work Group

FWWG I - Fish and Wildlife Work Group, GREAT I

GIS - Geographic Information System

ICC - Iowa Conservation Commission

MENWG - Material and Equipment Needs Work Group

NEPA - National Environmental Policy Act

O & M - Operation and Maintenance

OSIT - On-Site Inspection Team

PFWG - Plan Formulation Work Group

POA - Plan of Action

PPIWG - Public Participation and Information Work Group

RID - Rock Island District

RRT - Regional Response Team

RWG - Recreation Work Group

SCWG - Side Channel Work Group

SEWG I - Sediment and Erosion Work Group, GREAT I

UMR - Upper Mississippi River

UMRBC - Upper Mississippi River Basin Commission

UMRCC - Upper Mississippi River Conservation Committee

UMRWLFR - Upper Mississippi River Wild Life and Fish Refuge

USDA - United States Department of Agriculture

USEPA - United States Environmental Protection Agency

USFWS - United States Fish and Wildlife Service

USGS - United States Geological Survey

USSCS - United States Soil Conservation Service

WES - Waterways Experiment Station

WQWG - Water Quality Work Group

APPENDIX 25

INDEX OF FWMWG RECOMMENDATIONS

Recommedation Number	Problem Addressed	Short Title	Page
3017	5	Management plan for UMR	239
3018	-	incorporated into 3005	N/A
3019	2	Eliminate unwanted disposal on refuges	165
3020	6	Federal Railroad Administration assistance	261
3021	6	Contingency plan for spills	247
3022	6	Flood-proofing facilities in floodplain	251
3023	7	Year-round navigation studies	273
3024	3	Geographic information system	209
3025	3	Wing dam study	215
3026	3	Fish and wildlife monitoring plan	205
3027	4	Habitat development project	225
3028	1	Equipment for backwater alterations	157
3029	4	Assess cumulative impacts	222
3030	4	Monitor disposal sites	230
3031	3	Management of endangered and threatened species	218
3032	7	Impacts of navigation study	235
3033	7	Mitigation of navigation impacts	269
3034	7	Study impacts of barge fleeting	276
3035	1	Priority areas for backwater restoration	145

Recommendation Number	Problem Addressed	Short Title	Page
3036	1	Protection of Brown's Lake from sedimentation	149
3037	6	U.S. Coast Guard regulations	255
3038	6	U.S. EPA regulations	258
3039	5	Pool 19 management plan	235
3040	2	Modify backwaters impacted by dredging	196

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-8